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AUTHOR Gilbert, Glen G.; Ziady, Merrie
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ABSTRACT

This document contains experiments, demonstrations, and descriptions of computer software that may be useful in smoking education. Strategies are presented so that instructors can select the ones that are appropriate for their target populations. Experiments and demonstrations on the effects of smoking presented in this book are appropriate for elementary and secondary school students. Each of the 39 experiments or demonstrations includes descriptions of the purpose, appropriate age group, equipment, procedure, and discussion points; most include black and white illustrations. Some of the topics included are: (1) operation of healthy and diseased lungs; (2) accumulation of tar; (3) lung capacity; (4) simulation of reduction in taste and smell; (5) effects of cigarette smoke on plants; (6) smokeless tobacco effects; (7) effects of smoking on skin temperature; (8) smoking and blood pressure; (9) carbon monoxide levels of smokers versus non-smokers; (10) nicotine's effect on living organisms; (11) smoking and Vitamin C; (12) making a smoking machine; and (13) effects of carbon monoxide on blood. A listing of software for smoking education, a reference list for smoking education, and a resource list of agencies interested in smoking education are included. (ABL)

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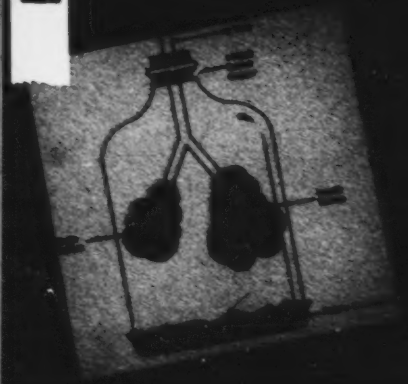
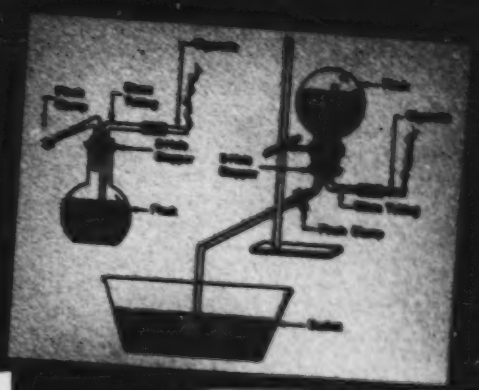
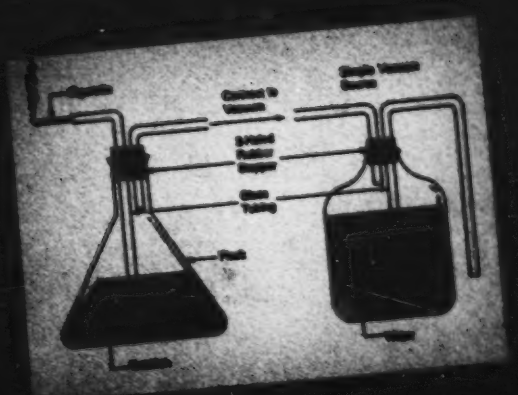


Experiments and Demonstrations in Smoking Education





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Each experiment was also tested by teachers. The authors wish to thank the following teachers and their students for serving as field testers: Tom Biller, E. Lee Cook, Laurie Denio, Bonnie Donaldson, Chris Evans, Howard Gonser, William Helm, Mary Karter, Gene Meyer, Ken Potter, and Regina Smelser.

This publication includes experiments, demonstrations and computer software that may be useful in smoking education. No claim is made that any individual strategy will produce a measurable behavior change in youth. The strategies are presented so that instructors or curriculum developers can select the ones that are appropriate for their target populations. However, the authors feel the following proverb should be considered when designing educational strategies:

"What I hear, I forget
What I see, I remember
What I do, I learn."

Chinese proverb - author unknown

PREFACE

Users are cautioned that, as with all scientific experiments, extra caution should be used in conducting these classroom activities. Instructors should review each activity before classroom use and observe all safety precautions. Experiments which produce smoke should be conducted in well ventilated areas or outside.

Some experiments call for the participation of a person or persons smoking. Such participation should be carried on only with permission of school authorities and in ways to avoid fire hazard or student's exposure to side stream smoke. Parental permission should be required for participation by students.

Many of the enclosed experiments have been used for many years and the original authors are unknown. Whenever original authors were identified, they are noted. In addition, several experiments were developed by students and the authors. All experiments have been field tested by classroom teachers and students.

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I. EXPERIMENTS AND DEMONSTRATIONS

#1. THE OPERATION OF A HEALTHY LUNG

A. PURPOSE:

To show the proper functioning of lungs during normal breathing. If both lungs are functioning normally they inflate and deflate properly.

B. APPROPRIATE AGE GROUP:

Intermediate through Middle School

C. EQUIPMENT:

1. Bell jar
2. 2 rubber balloons similar in size and elasticity
3. Rubber sheet (not required with many bell jars)
4. Y or T- plastic tube
5. One-holed stopper

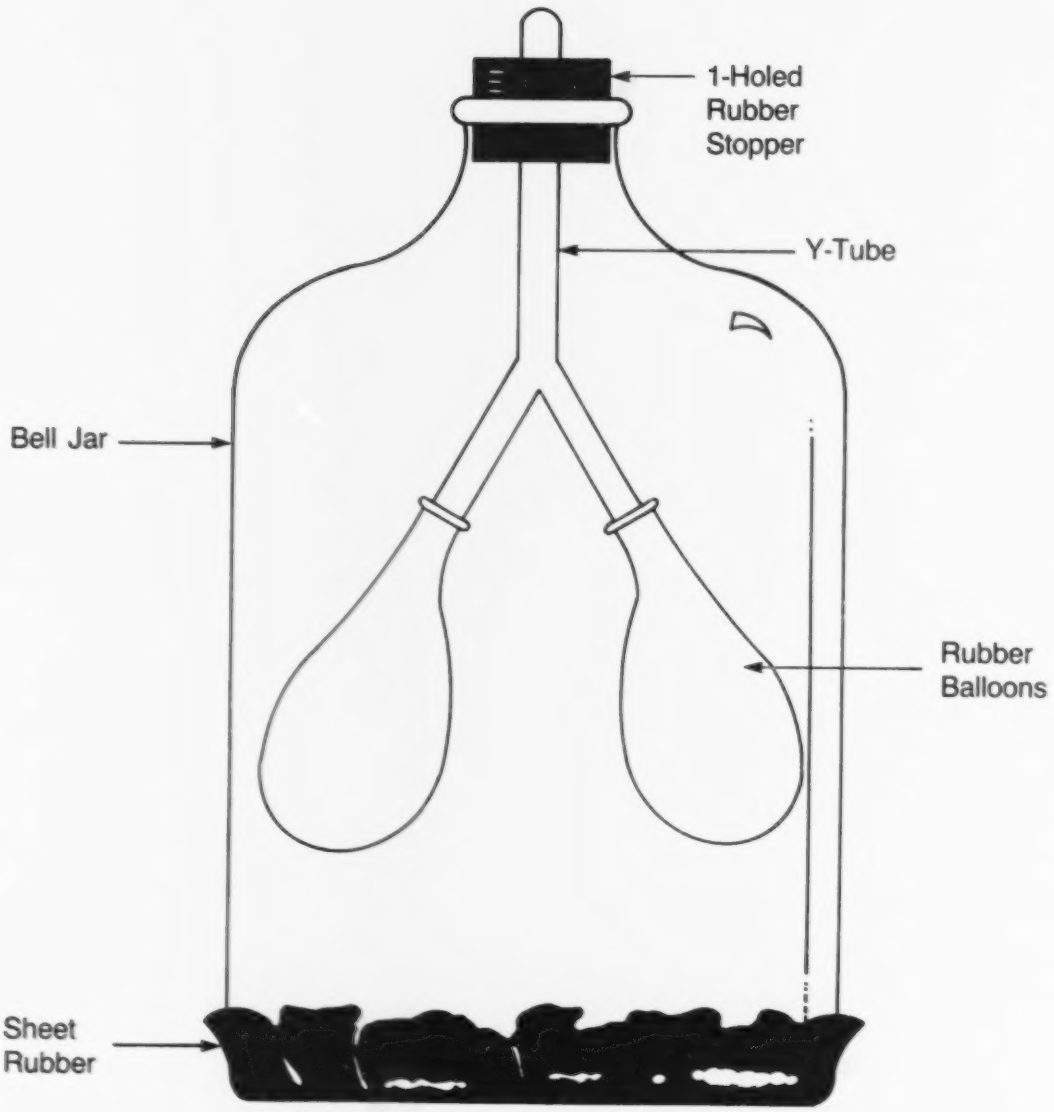
D. PROCEDURE:

1. Set up apparatus as shown in illustration, observing safety measures necessary for safe insertion of tube in rubber stopper.
2. Pull down on rubber sheet and observe the balloons filling with air. (Fastener required to secure rubber sheet).
3. Push the rubber sheet up into the jar and observe the action of the balloons.
4. The action of filling and emptying of the balloons may be compared to respiration, with the balloons representing the lungs and the rubber sheet the diaphragm.
5. Consider moving on to experiment #2.

E. KEY POINTS FOR DISCUSSION:

1. What causes your lungs to inflate and deflate?
2. How do you get oxygen before you are born?
3. What are lobes?
4. Can we replace lungs?
5. Even if we could replace lungs - would they be as good as the originals?
6. Often balloons do not expand to the same size. Why is this so? Would the same be true if one lung is diseased?

#1 The Operation of A Healthy Lung



#2. SIMULATED DISEASED LUNG

A. PURPOSE:

To demonstrate the effect of emphysema on breathing and to explain the relationship of smoking to heart and circulatory function.

B. APPROPRIATE AGE GROUP:

Intermediate through Middle School

C. EQUIPMENT:

1. Forked plastic tubing @ 1/2 cm.
2. Bell jar
3. One-holed rubber stopper
4. Rubber sheet or membrane
5. Balloons similar in size and elasticity

D. PROCEDURE:

NOTE: *Advance preparation required—blow up balloons in advance.*

1. Blow up one balloon and allow it to remain inflated for a day or two. When ready for demonstration, deflate the balloon and note that it remains enlarged and stretched.

2. Insert an unused balloon into the used one.

3. Attach a new single balloon to one of the ends of the forked glass tube and the double balloon to the end of the other tube. Fasten a rubber sheet or membrane across the bottom of the bell jar to simulate the diaphragm.

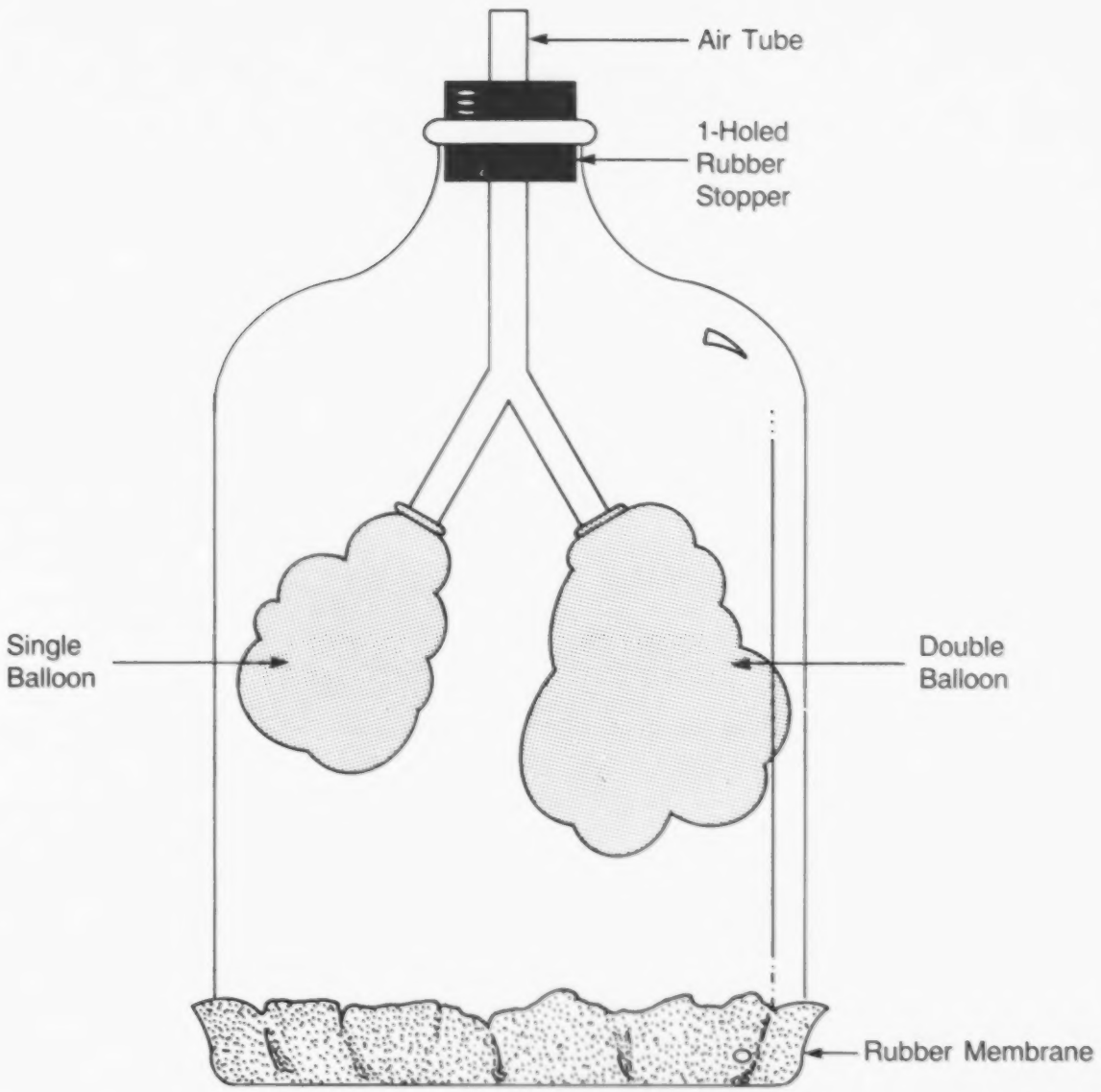
4. Pull down on the center of the rubber membrane and observe the balloons filling with air. Note the amount of expansion that takes place in both balloons. Push the rubber membrane back up into the jar a short way to simulate exhaling. Note the difference in the deflation of the "lungs".

5. The action of filling and emptying the balloons may be compared to respiration. If both lungs are functioning properly, they inflate and deflate properly. But if the alveoli of the lungs have been destroyed or have lost their elasticity, as in emphysema, the individual has difficulty in getting oxygen into the circulatory system because blood vessels in the alveoli have been destroyed. Too, the individual has difficulty in exhaling air because some of the alveoli have lost their ability to contract and push air out. All of this causes an added strain on the heart and circulatory system.

E. KEY POINTS FOR DISCUSSION:

1. What factors influence lung capacity?
2. What are the effects of emphysema on the lungs?
3. Have any of you observed a person with emphysema? How did they breathe?
4. Can a diseased lung be surgically removed or replaced?
5. How does emphysema affect prospects for removal of the lung or lungs?
6. Can the human body repair a damaged lung?

#2 Simulated Diseased Lung



#3. RESIDUE PRODUCED BY CIGARETTES

A. PURPOSE:

To observe residue of cigarette smoke on inside walls of a flask or beaker, and to observe the change in the color of the water.

B. APPROPRIATE AGE GROUP:

Middle through Secondary School

C. EQUIPMENT:

1. Flask (the larger the better)
2. Two-holed stopper
3. Glass tubing (or plastic, if available)
4. Rubber tubing
5. Pinch clamp
6. Cigarettes
7. Stand

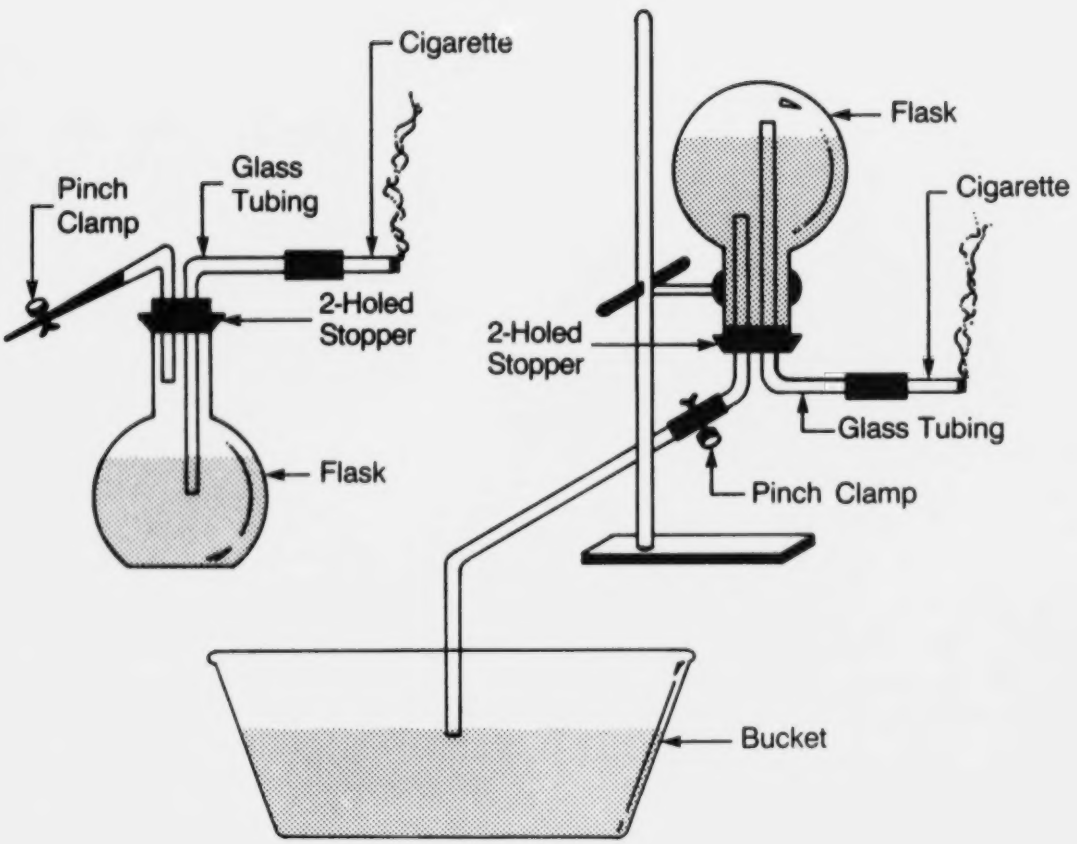
D. PROCEDURE:

1. Fill flask approximately three-fourths full of water. Close the flask with a two-holed stopper fitted with glass tubes. Invert the flask holding finger over end of tube until inversion is complete.
2. Fit a cigarette into one end of a piece of rubber tubing attached to glass tube as shown.
3. Start the siphon and light the cigarette. The pinch clamp may be used to open or close inverted flask to wash the smoke with water. Note the inside walls of the flask.

E. KEY POINTS FOR DISCUSSION:

1. What happens to your lungs when you smoke?
2. How does your body try to defend itself from smoke?
3. How do cilia function?
4. What are some of the diseases related to smoking?
5. If someone has smoked for twenty years, and stops, what happens?
6. Can the body repair damage caused by years of smoking?

#3 Residue Produced By Cigarettes



#4. ACCUMULATION OF TAR #1

A. PURPOSE:

To show the accumulation of tar in water.

B. APPROPRIATE AGE GROUP:

Middle through Secondary School

C. EQUIPMENT:

1. Container with a two-holed stopper
2. Large gallon jar with a two-holed stopper
3. Bucket or pan
4. Several cigarettes
5. Delivery tubes (glass)
6. Cigarette holder

D. PROCEDURE:

1. Assemble the cigarette tar separating apparatus as shown in the diagram.
2. Fill the small jar half full of water.
3. Fill the large jar to the top with water.
4. Place a cigarette in the cigarette holder and light it.
5. Start the flow of water from the large jar into the bucket by sucking the water in the outlet tube to start the water siphoning out of the large jar. This will create a suction in the jars and cause the cigarette to burn. The tars will collect in the water in the small jar.

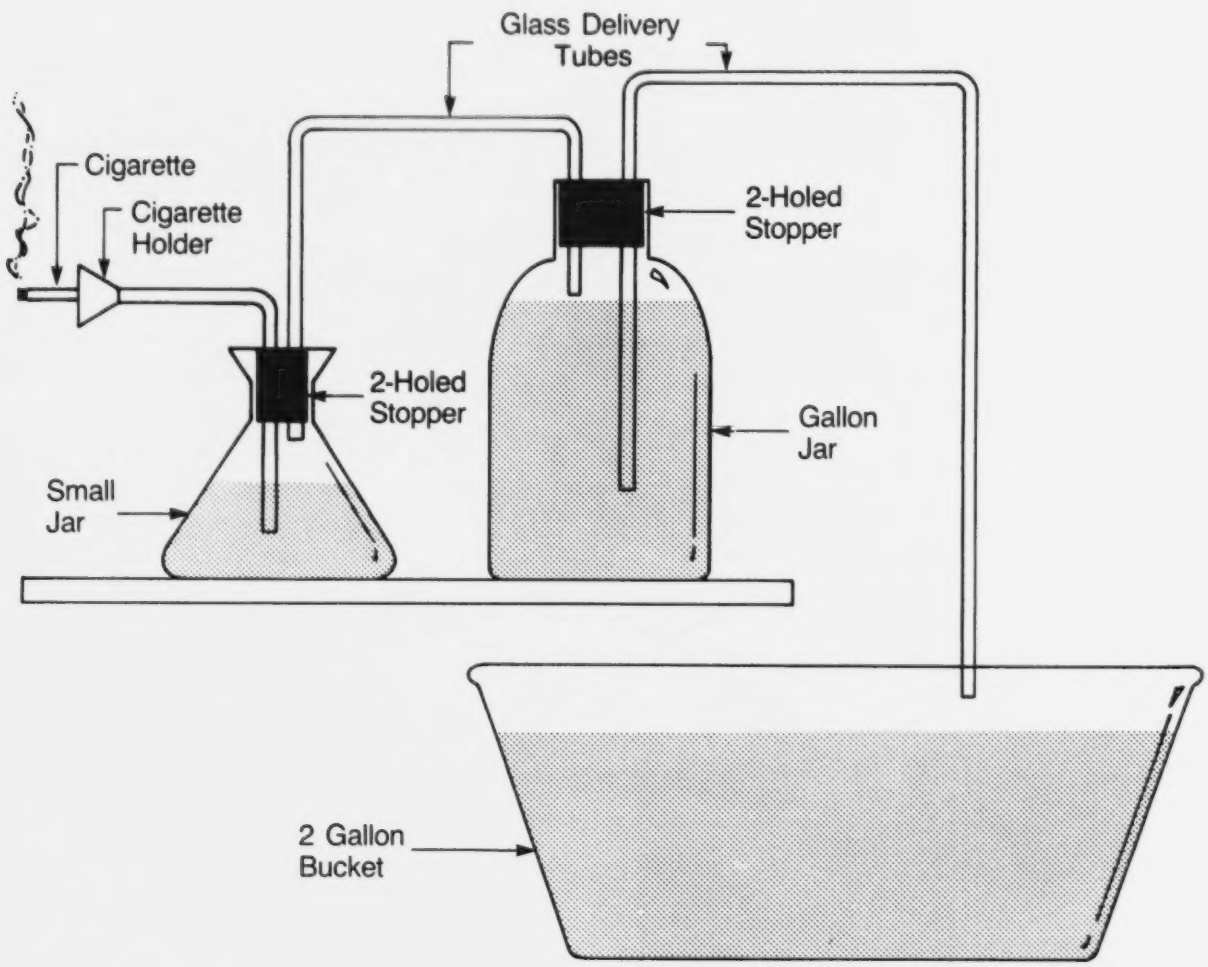
   CAUTION: *Observe sterile technique.*

6. Allow the cigarette to burn completely. Add more water to the large jar if necessary to maintain suction.

E. KEY POINTS FOR DISCUSSION:

1. What happens to your lungs when you smoke?
2. How is this experiment similar to what happens to your lungs if you smoke?
3. How does your body keep the lungs clean and filter the air?

#4 Accumulation of Tar #1



#5. ACCUMULATION OF TAR #2

A. PURPOSE:

To show the accumulation of tar in water by change of color and smell.

B. APPROPRIATE AGE GROUP:

Middle through Secondary School

C. EQUIPMENT:

1. Gallon jar with a two-holed stopper
2. Cigarettes and matches
3. Delivery tubes (glass, plastic or rubber hose)
4. Cigarette holder
5. Hand squeeze pump or vacuum pump

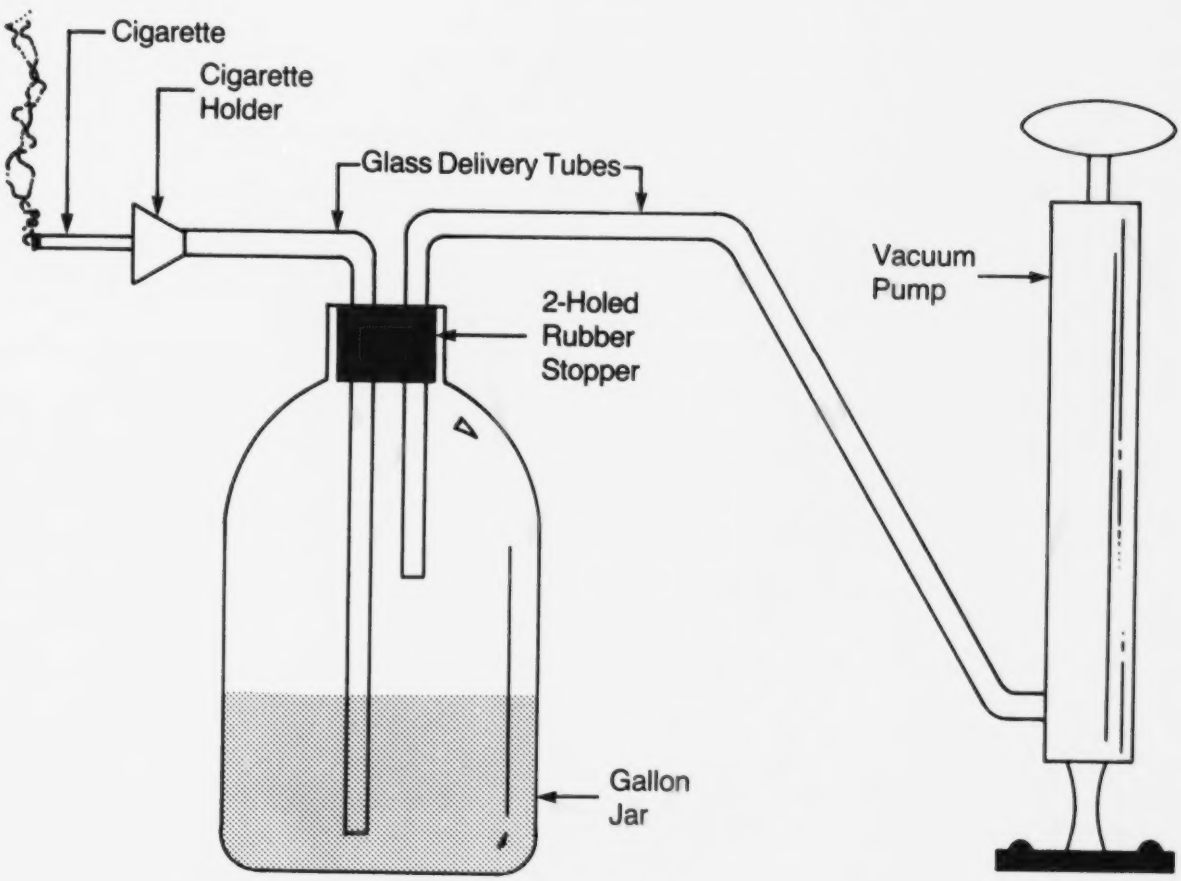
D. PROCEDURE:

1. Assemble cigarette tar separating apparatus as shown in the diagram.
2. Fill the gallon jar half full with water.
3. Place cigarette in intake and light.
4. Using vacuum pump, draw smoke from cigarette into gallon jar and water.
5. Pump until cigarette is burned completely. Replace with additional cigarettes until tars can be seen in water.
6. Examine color and smell of water.

E. KEY POINTS FOR DISCUSSION:

1. What happens to your lungs when you smoke?
2. What are the similarities between this experiment and what happens to lungs?
3. What chemicals are in the water?
4. Where can we find out more about the effects of smoking?
5. How does your body rid itself of these tars?

#5 Accumulation of Tar #2



#6. ACCUMULATION OF TAR #3

A. PURPOSE:

To show the accumulation of tar in cotton balls.

B. APPROPRIATE AGE GROUP:

Primary School

C. EQUIPMENT:

1. Plastic window cleaner container, or other empty plastic container, transparent if possible
2. Ball point pen barrel or other tubing approximately the size of a cigarette
3. Cotton
4. Cigarettes and matches
5. Ash tray or other item to catch ashes

D. PROCEDURE:

You may wish to conduct experiments outside or with the windows open to avoid side stream smoke.

1. Rinse the container thoroughly.
2. Make an opening in the cap of the container to fit the tubing into the cap.
3. Place the tubing in the opening and seal tight with cement or clay if needed.
4. Insert loosely packed cotton ball into tubing.
5. Insert cigarette into open end of tubing.
6. Press firmly on the plastic container to force air out, lighting the cigarette, and then proceed with slow and regular pumping action.
7. Withdraw cotton from tubing to show accumulation of tar.
8. Pass container around for individuals to smell and to observe that smoke continues to be expelled for a period of time.

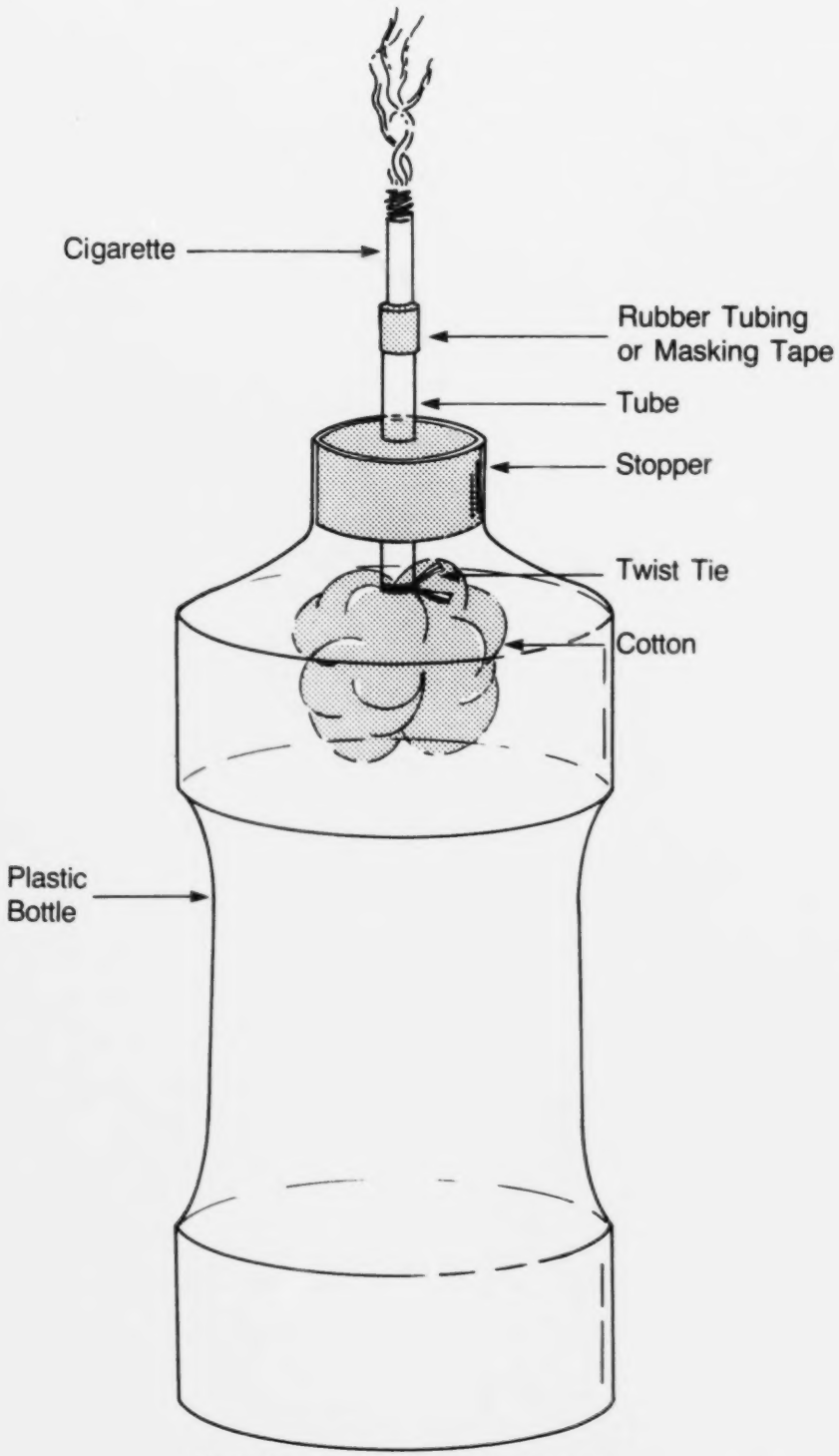
VARIATION:

1. Divide into groups and conduct several experiments keeping close supervision for safety.
2. Try same experiment with filter cigarette.
3. Compare filter and non-filter cigarettes.

E. KEY POINTS FOR DISCUSSION:

1. What happens to your lungs when you smoke?
2. Is this experiment similar to what happens to your lungs?
3. Consider this effect multiplied by 20 or 30 times per day for 5, 10, or 20 years?

#6 Accumulation of Tar #3



Variation is a two holed stopper.

#7. ACCUMULATION OF TAR #4

A. PURPOSE:

To demonstrate the accumulation of tar on cotton or tissue.

B. APPROPRIATE AGE GROUP:

Primary through Secondary School

C. EQUIPMENT:

1. Large plastic syringe (may be available from your local American Cancer Society) or use meat baster
2. Cotton or tissue
3. Cigarettes and safety matches

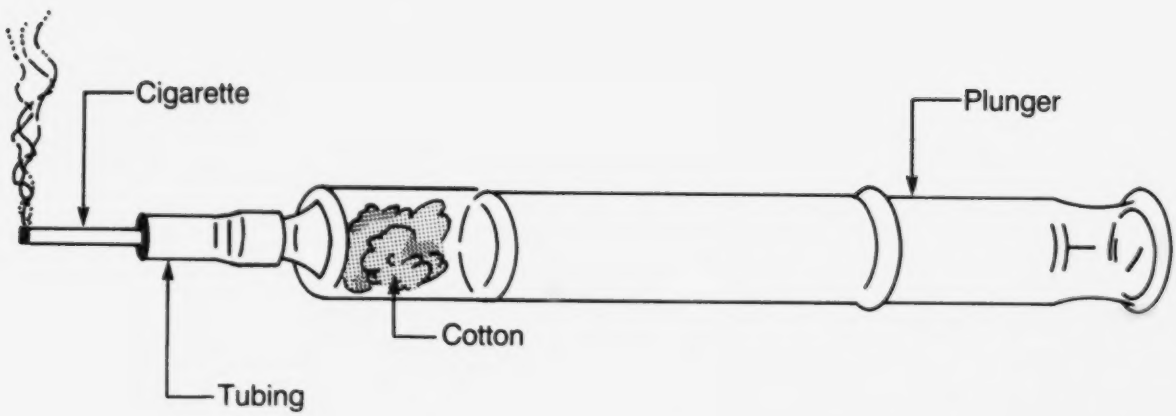
D. PROCEDURE:

1. Place cotton or tissue in opening of syringe.
2. Place filter end of lighted cigarette in opening of syringe.
3. Pump the syringe to smoke the cigarette.
4. After smoking one or more cigarettes, remove cotton or tissue and observe the accumulation of tars.
5. Smell the cotton or tissue.

E. KEY POINTS FOR DISCUSSION:

1. What happens to your lungs when you smoke?
2. How is this experiment similar to what happens to your lungs if you smoke?
3. Does tar cause any diseases? What diseases?
4. Can you tell if someone is a smoker when they are not smoking? How do they smell different?

#7 Accumulation of Tar #4



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#8. ACCUMULATION OF TAR #5

A. PURPOSE:

To demonstrate the accumulation of tar deposit on the air passages of the smoker.

B. APPROPRIATE AGE GROUP:

Secondary School

C. EQUIPMENT:

1. Ringstand and clamp
2. Pinch clamps
3. Two one gallon jars
4. Long, narrow flask or bottle
5. Two-holded rubber stoppers to fit jars
6. Two one-holed rubber stoppers to fit flask
7. Six feet of glass tubing
8. Four to five feet of clear plastic tubing
9. Rubber tubing
10. Cigarettes and safety matches
11. Cotton pellets

D. PROCEDURE:

1. Place the cotton pellets in a piece of glass tubing so they are not touching each other.
2. Set up the equipment as shown in the diagram.
3. Suction is created by the gravity flow of water from the full jar to the empty one. When all of the water has escaped from the upper jar, it should be replaced by the one which is now full.
4. Place a cigarette in the rubber tube at the end of the line issuing from the small flask.
5. Remove the pinch clamps [1] and [2] and light the cigarette. The pinch clamp [1] should be released and tightened periodically to simulate a smoker drawing on a cigarette. The smoke should bubble through the water in the small flask.
6. As the cigarettes are smoked, tar will collect on the cotton pellets. An empty flask can be substituted for the small water-filled flask to collect smoke.

VARIATION:

1. Substitute 3 to 4 feet of clear plastic tubing for the collection jars to demonstrate/simulate the accumulation of tar deposits on the air passages of a smoker.

E. KEY POINTS FOR DISCUSSION:

1. What happens to your lungs when you smoke?
2. What is tar? What diseases are associated with the accumulation of tar?
3. How does the human body react to and deal with these tars?

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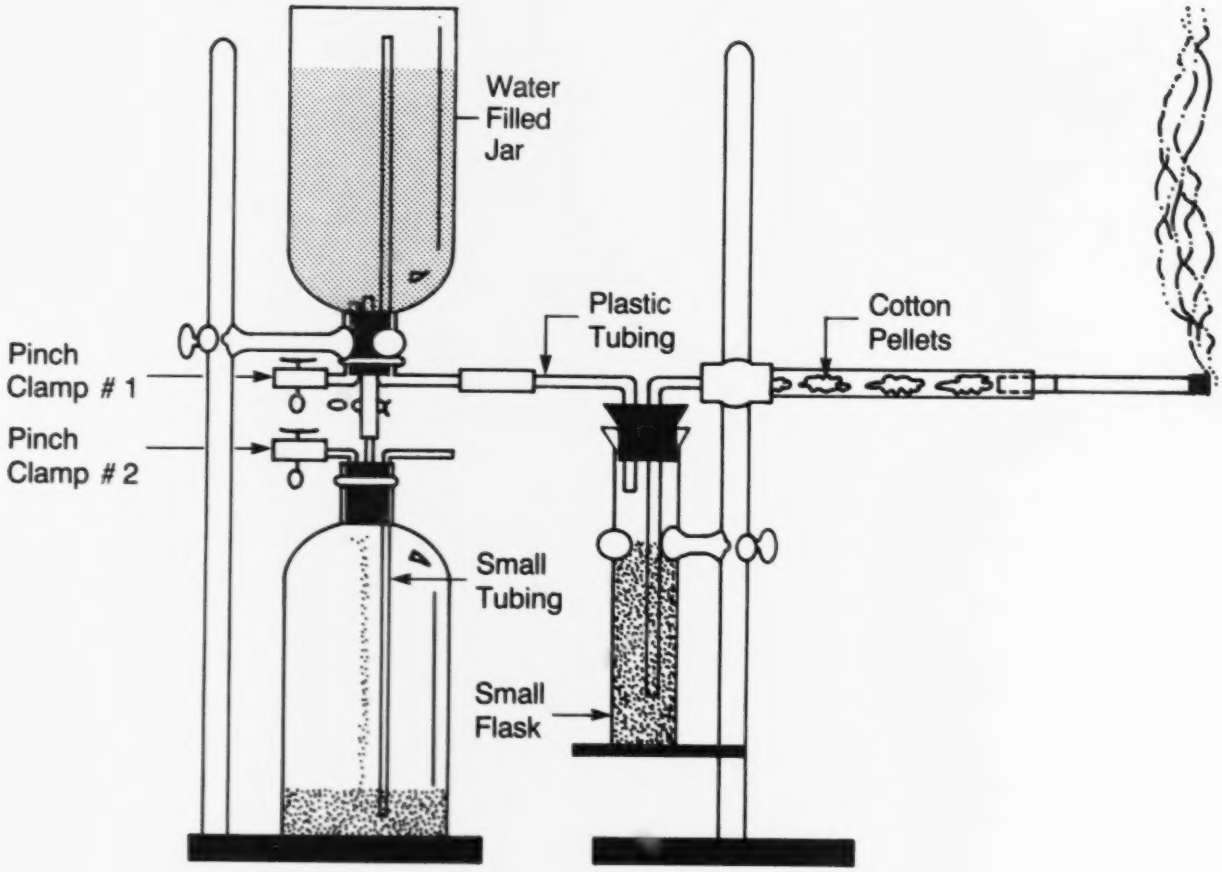
#8 Accumulation of Tar #5



#9. SIMULATED EMPHYSEMA

A. PURPOSE:

To show the impaired respiratory function of a person with emphysema.

B. APPROPRIATE AGE GROUP:

Primary through Secondary School

C. EQUIPMENT:

1. Safety matches or candle in a holder

D. PROCEDURE:

1. Hold lighted match or candle approximately 6 inches from open mouth of a volunteer. A candle in a holder may be used to avoid the possibility of burning fingers while holding the match.
2. Have a student blow it out. Continue to move it farther away until it cannot be blown out. This is to demonstrate healthy lungs.
3. Repeat process using the steps below simulating a diseased lung.
4. Have volunteer expel as much air as possible from lungs.
5. Have the volunteer try to blow out the flame without taking a deep breath and without pursing his/her lips. As with the emphysema patient, the volunteer will not be able to blow out the match. This shallow breathing is typical of the emphysema patient.
6. Have a container filled with water for students to deposit hot match.

E. KEY POINTS FOR DISCUSSION:

1. What is emphysema?
2. What can be done to prevent emphysema?
3. Why do some emphysema patients continue to smoke?
4. Why is it that a person with emphysema cannot blow out the match?
5. Do any of you know a person with emphysema? What is this person's life like?

#9 Simulated Emphysema

#10. SIMULATED BLOOD VESSEL CONSTRICTION

A. PURPOSE:

To illustrate the constricting effects of cigarette smoking upon blood vessels.

B. APPROPRIATE AGE GROUP:

Primary through Secondary School

C. EQUIPMENT:

1. 2 straws or plastic tubes with different diameters
2. 2 glasses of water
3. Catch basin

D. PROCEDURE:

1. Fill two glasses with equal amounts of water.
2. Ask for two student volunteers. Give each student a straw and instruct them to blow into the straws continuously. Set time limit for about 15 seconds.
3. Have class predict and then determine which student must blow the hardest, and which student tires more easily.

VARIATION:

1. Have two students pour an equal amount of liquid through two funnels with different size openings. Note flow rate.
2. Consider making it a contest.
3. Combine with experiment #2.
4. Consider graphing results.

E. KEY POINTS FOR DISCUSSION:

1. Draw the analogy that when a person smokes, his blood vessels are constricted (like the smaller straw) thus causing the heart to work harder to pump blood through the vessels.
2. What is hypertension? What do you think would be the effects for someone who smokes and has hypertension?
3. What is Buerger's disease?
4. What do people do to relieve hypertension?

Related Experiments: #19, 26, 28, 30, 31

#10 Simulated Blood Vessel Constriction

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#11. LUNG CAPACITY DEMONSTRATION #1

A. PURPOSE:

To show the effects of cigarette smoking on lung capacity.

B. APPROPRIATE AGE GROUP:

Intermediate through Secondary School

C. EQUIPMENT:

1. Bottle (two liter or larger, depending on students)
2. Graduated cylinder
3. Two-holed rubber stopper
4. Rubber tube
5. Glass tubing

D. PROCEDURE:

1. Set up apparatus as shown in illustration.
2. Fill the bottle with water colored with vegetable dye.
3. Have subject blow through rubber tube and note that the air pressure forces water out of the bottle into the graduated cylinder.
4. The volume of water displaced each time the subject exhales is a measure of the amount of air displaced from his lungs.
5. By using a long rubber tube, the volume of water displaced when the subject is exercising, such as running in place, can be measured.

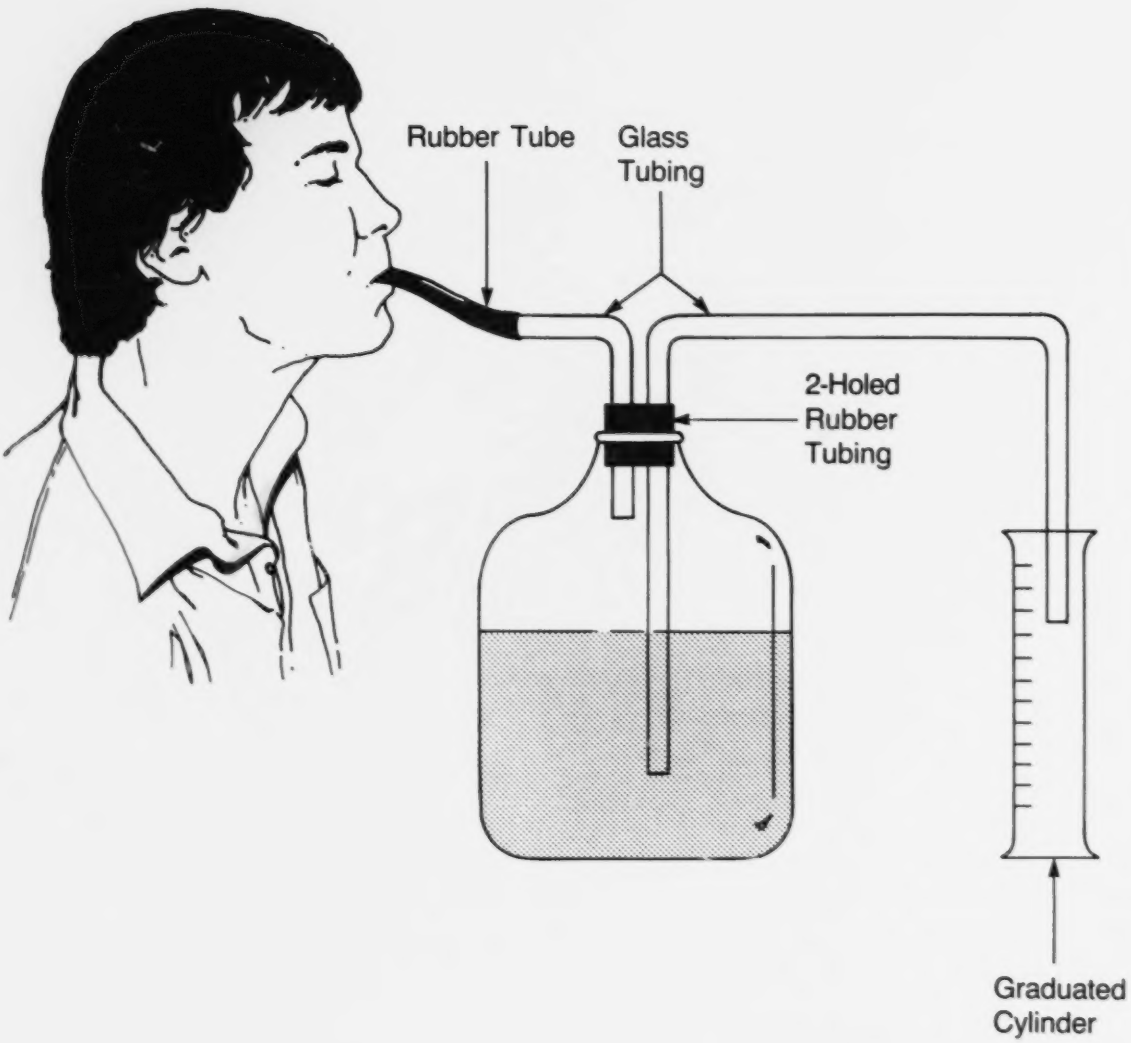
VARIATION:

1. Consider using with experiments 9 and 10.

E. KEY POINTS FOR DISCUSSION:

1. What is lung capacity?
2. How is lung capacity determined?
3. How is lung capacity related to endurance?
4. How do diseases influence lung capacity?
5. What can cause lung capacity to get smaller?
6. How can a person increase their lung capacity?
7. How does exercising help lung capacity and other parts of the body?

#11 Lung Capacity Demonstration #1



#12. LUNG CAPACITY DEMONSTRATION #2

A. PURPOSE:

To observe and compare lung capacity.

B. APPROPRIATE AGE GROUP:

Intermediate through Middle School

C. EQUIPMENT:

1. Dishpan
2. Rubber tubing about two feet long (mouth piece or straw if available)
3. Gallon jug (preferably transparent plastic jug such as a milk jug). You may want to mark the volume levels on the jug using a permanent marker.
4. Measuring cup
5. Water (may be best to use a room with a water supply)
6. Towel
7. Funnel

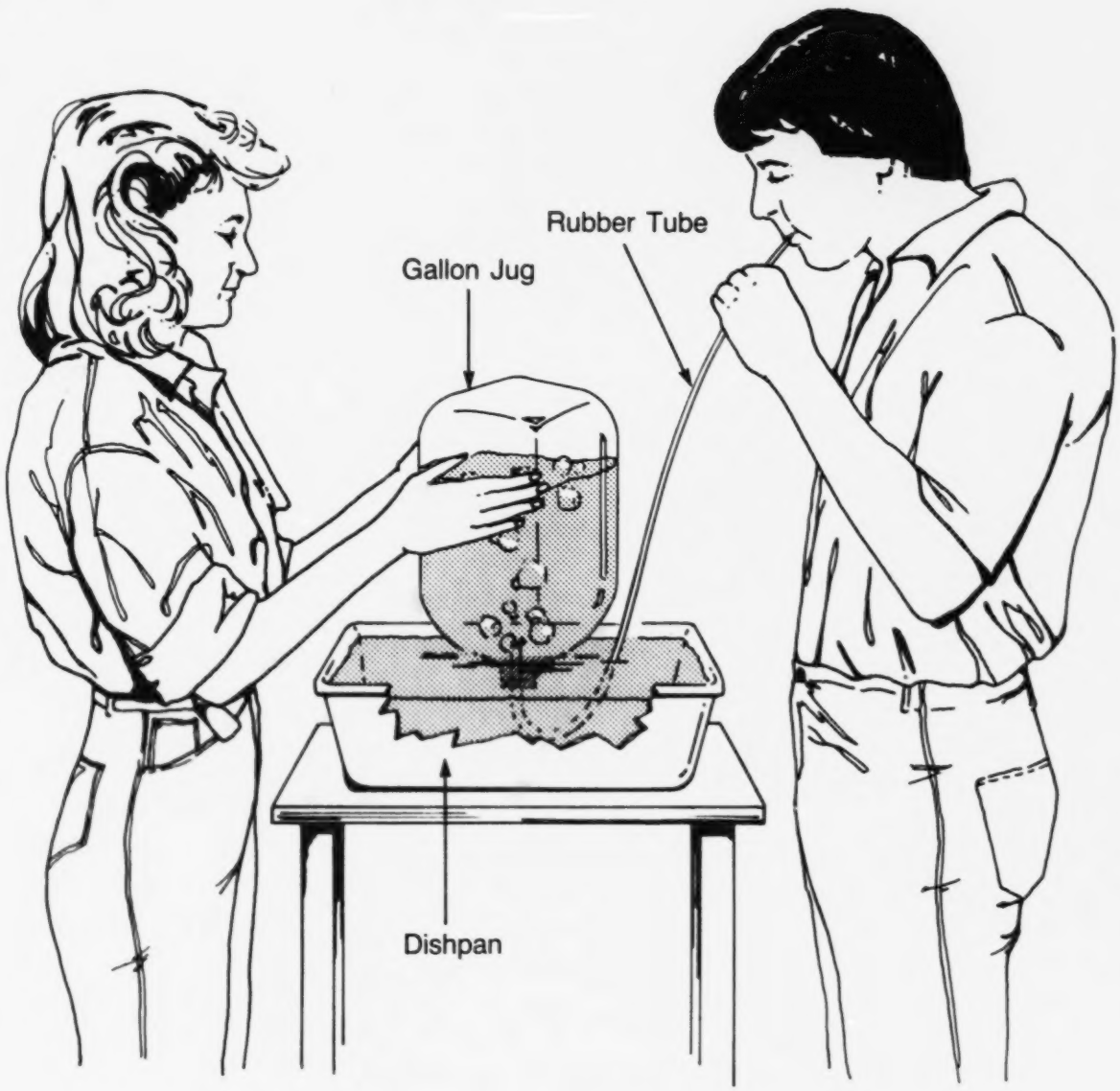
D. PROCEDURE:

1. Fill the dishpan about a quarter full.
2. Fill the gallon jug.
3. Put your hand tightly over the mouth of the jug and turn it upside down in the pan. Don't let air get into the jug.
4. Carefully wash the ends of the tubing.
5. Put one end of the tubing into the mouth of the jug.
6. Blow into the other end until you have exhaled as much air as you can.
7. Remove the tubing.
8. Carefully slide your hand tightly over the mouth of the jug and turn it right side up. Do not let water escape. Adult may need to help.
9. To see how much air you exhaled use the measuring cup to fill the jug again. The amount of water needed to fill the jug is the same as the amount of air you exhaled.
10. If repeated be certain to use clean mouth piece or clean hose.

E. KEY POINTS FOR DISCUSSION:

1. What is lung capacity?
2. How does the lung capacity of boys compare to girls?
3. How is lung capacity influenced by smoking? diseases?
4. What other comparisons could be made (athletics, adults, smokers or non-smokers)?

#12 Lung Capacity Demonstration #2



#13. SIMULATED REDUCTION IN SENSE OF TASTE

A. PURPOSE:

To show the numbing effect of tobacco on taste buds.

B. APPROPRIATE AGE GROUP:

Primary through Middle School

C. EQUIPMENT:

1. Ice cubes
2. Solutions of sweet, sour, bitter, and salty substances — vinegar, lemonade, dill pickle juice, lemon juice, soy sauce, onion, and hot mustard
3. Cotton-tip applicators (several for each use)
4. Glasses of water for rinsing
5. Spitting vessel (spittoon)

D. PROCEDURE:

NOTE: *Advance set-up required - need ice cubes*

1. The sense of taste and smell are usually less sensitive in smokers due to the numbing effect of tobacco on sensory endings in the nose and throat. This effect may be compared with the effect of extreme cold.
2. Apply an ice cube to the tongue of a volunteer. (Caution: do not leave tongue on ice too long). Remove ice just before applying solution.
3. Determine his/her ability to taste sweet, sour, bitter, and salty substances by applying these substances to the tongue of a volunteer after the ice has been applied. Blindfold and ask volunteer to hold his/her nose to test the role of sight and smell in food recognition.
4. Observe and record the time it takes for students to react.

E. KEY POINTS FOR DISCUSSION:

1. What effect do the ice-cubes have on the tastebuds? How is that similar to the effect of tobacco on the tastebuds?
2. When smokers stop smoking cigarettes, how does it affect the way they taste food?
3. What part does the odor of the substance play?

#13 Simulated Reduction in Sense of Taste

#14. SIMULATED LOSS OF SMELL

A. PURPOSE:

To show that the sense of taste is affected by the sense of smell.

B. APPROPRIATE AGE GROUP:

Primary through Middle School

C. EQUIPMENT:

1. Slices of apple
2. Slices of potato
3. Nose plugs (soft, or plug nose with fingers)
4. Blindfold

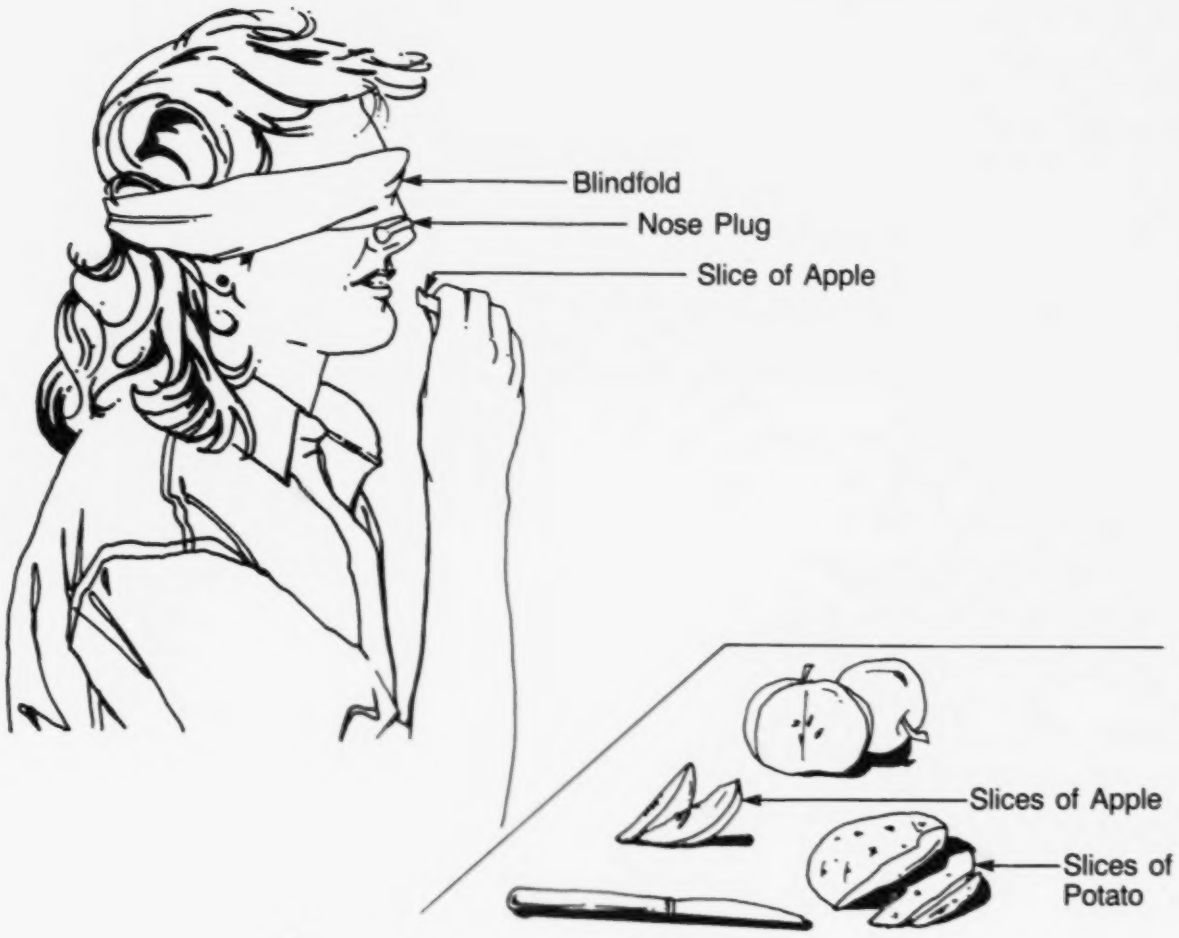
D. PROCEDURE:

1. Do not let students know what will be tasted.
2. Place blindfold over eyes.
3. Place nose plug over nostrils.
4. Taste apple.
5. Taste potato.
6. When the nose is plugged, an individual cannot distinguish variations in taste. When one smokes, the *olfactory nerve* is desensitized resulting in similar effects.
7. You might like to test and compare results from smoking and non-smoking adults.

E. KEY POINTS FOR DISCUSSION:

1. How does smoking affect the sense of smell?
2. What effect does smoking have on the smoker's clothes?
3. What have you noticed about the smell of cigarette smoke on smokers?
4. How do you feel about hugging or kissing someone who smokes?
5. What can be done to encourage someone not to smoke?

#14 Simulated Loss of Smell



#15. THE EFFECTS OF CIGARETTE SMOKE ON PLANTS

A. PURPOSE:

To show the effect of cigarette smoke on the growth of plants.

B. APPROPRIATE AGE GROUP:

Primary and Intermediate School as teacher demonstration,
Middle School as classroom project

C. EQUIPMENT:

1. 2 terrariums, each with some plants (5 gallons or less)
2. Hand squeeze pump
3. Glass and plastic tubing
4. Cigarettes and safety matches

D. PROCEDURE:

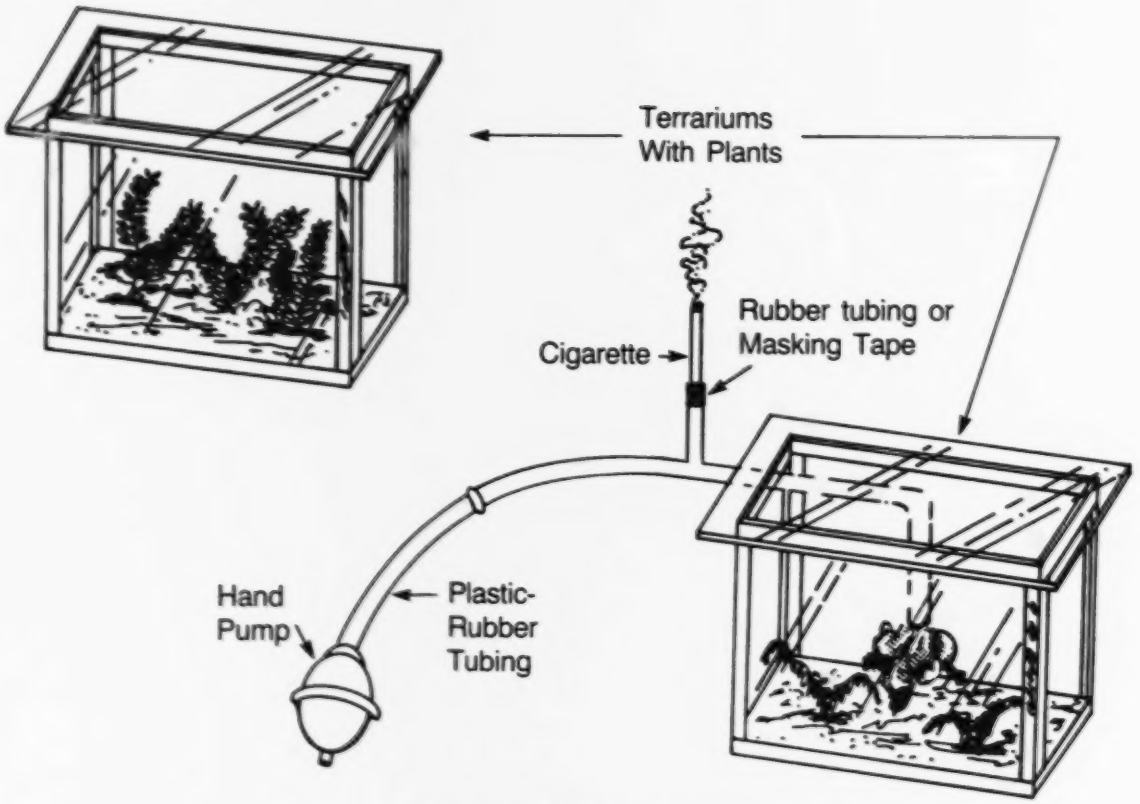
It is suggested this be conducted near a window or outside to avoid second hand smoke.

1. Prepare two terrariums with identical plants, light, etc.
2. Pump smoke into one terrarium over a period of time (at least two weeks). Close terrarium end when inhaling so air comes in through cigarette.
3. Do not repeat procedure with second terrarium.
4. Observe daily and compare the growth of the plants in the two terrariums. The plants will not grow as effectively in the smoke-filled terrarium.

E. KEY POINTS FOR DISCUSSION:

1. What is it about the smoke that retards plant growth?
2. Cigarette smoke contains tar, nicotine, carbon monoxide, hydrogen cyanide, nitrous oxide and other gases. How might these products influence plant growth? How do those products influence human smokers?
3. What is it like to be on an elevator or in a small room with a smoker?
4. What is the purpose of the second terrarium? (control)

#15 The Effects of Cigarette Smoke on Plants



Effect of Cigarette Smoke on
Growth of Plants

#16. INHALED AND EXHALED CIGARETTE SMOKE COMPARISON

A. PURPOSE:

To demonstrate the difference in the amount of tar in inhaled and exhaled smoke.

B. APPROPRIATE AGE GROUP:

Intermediate through Secondary School

C. EQUIPMENT:

1. 1 white handkerchief or white tissue
2. Cigarettes and safety matches

D. PROCEDURE:

1. Have an adult volunteer smoker inhale from a lighted cigarette, making every attempt to hold the smoke just in his mouth without allowing it to go to the lungs. As rapidly as possible, after inhaling the smoke, place the clean handkerchief over the mouth and stretch as firmly as possible. Blow the smoke out through the handkerchief. Note stains on handkerchief.

2. Have the person inhale once more, only this time have him/her allow the smoke to go well into the lungs. Repeat the use of the handkerchief over the mouth while exhaling. Note that the second stain is lighter than the first stain. The difference between the two stains theoretically represents the amount of tar which remains in the lungs after each puff on a cigarette.

VARIATION:

1. Use two or more adult volunteer smokers and compare results.
2. Use filter and non-filter cigarettes and compare results.

E. KEY POINTS FOR DISCUSSION:

1. What is tar?
2. What effect does tar have on the lungs? cilia? epithelial cells?
3. What are the effects of tobacco tar on other parts of the body?
4. How does the body rid itself of these chemicals?
5. Does a filter tip help the problem?

#16 Inhaled and Exhaled Cigarette Smoke Comparison

#17. THE PHYSIOLOGY OF CILIARY ACTION AND THE EFFECT OF CIGARETTE SMOKE IN THE RESPIRATORY TRACT

A. PURPOSE:

To demonstrate how cigarette smoke affects the cilia and promotes cancer producing action in the respiratory tract.

B. APPROPRIATE AGE GROUP:

Middle through Secondary School

C. EQUIPMENT:

1. Two fresh chicken tracheas (large) NOTE: *Tracheas must be fresh (same day if possible).*
2. Block of wood, pins
3. India ink
4. Stopwatch
5. Metric ruler
6. Cigarette smoke

D. PROCEDURE:

1. Slit two *fresh* chicken tracheas upward from below and pin to a block of wood so that the inside, with cilia, can be viewed.

2. Put a small drop of India ink on the mucous membrane at the lower end of the first trachea, and place it in a moist chamber with the upper end elevated, so the ink will have to travel against gravity. (see figure)

3. Note the rate of travel with a metric ruler and stopwatch. The usual rate is about 10 millimeters per minute.

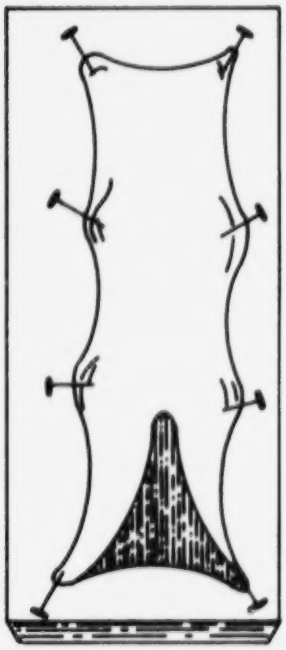
4. Do the same with the second trachea and blow smoke against the mucosa. What happens to the ciliary action?

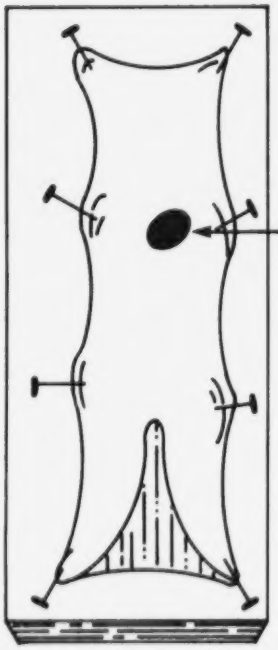
5. When the cilia are inactivated, the cancer producing agents in the mucous stay longer in contact with the lining of the respiratory tract.

E. KEY POINTS FOR DISCUSSION:

1. What is the function of cilia in the respiratory system?
2. What component of cigarette smoke inactivates the cilia?
3. What effect might the inactivation or destruction of cilia have on the respiratory tract of a smoker?
4. What are two respiratory diseases (other than lung cancer) that are related to smoking?
5. What happens to the cilia if a person stops smoking?
6. What else might affect the cilia in addition to cigarette smoke?

#17 The Physiology of Ciliary Action and the Effect of Cigarette Smoke in the Respiratory Tract





Here the Ink Deviated to the Right Hand Margin to Go Around the Smoke Fumes.

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#18. CONSTRUCTING A LIFE TABLE

A. PURPOSE:

To compare the survival rates of smokers with the survival rates of nonsmokers by constructing a life table.

B. APPROPRIATE AGE GROUP:

Intermediate through Secondary School

C. EQUIPMENT:

Graph paper

D. PROCEDURE:

Life insurance companies use life tables to calculate insurance risks and establish insurance rates. Actuaries for the State Mutual Life Assurance Company of Massachusetts have developed the data shown on the following two pages, showing the differing death rates of male smokers and nonsmokers, beginning at age 35. Using these data, develop a graph showing survival rates of smokers and nonsmokers.

E. KEY POINTS FOR DISCUSSION:

1. By examining the graph you have developed, identify at what age 50 percent of nonsmokers will still be living and at what age, 50 percent of smokers will still be living.
2. What other life styles might show similar differences in survival rates and life expectancies?

#18 Constructing a Life Table

	Smokers				*Nonsmokers*		
Age	Number Alive at Beginning of Year	Expected Deaths During Year Per 1,000	Expected Deaths During Year	Age	Number Alive at Beginning of Year	Expected Deaths During Year Per 1,000	Expected Deaths During Year
35	100,000	1.53	153	35	100,000	.45	45
36	99,847	1.65	165	36	99,955	.50	50
37	99,682	1.84	183	37	99,905	.56	56
38	99,499	2.02	201	38	99,849	.61	61
39	99,298	2.33	231	39	99,788	.71	71
40	99,066	2.65	263	40	99,717	.83	83
41	98,804	2.99	295	41	99,635	.94	94
42	98,509	3.41	336	42	99,541	1.06	106
43	98,173	3.79	372	43	99,435	1.19	118
44	97,801	4.20	410	44	99,317	1.35	134
45	97,390	4.75	463	45	99,183	1.53	152
46	96,927	5.43	526	46	99,031	1.75	173
47	96,401	6.06	584	47	98,858	1.96	194
48	95,817	6.71	643	48	98,663	2.24	221
49	95,174	7.51	715	49	98,443	2.50	246
50	94,459	8.41	794	50	98,197	2.80	275
51	93,665	9.33	874	51	97,922	3.11	305
52	92,791	10.16	943	52	97,617	3.50	342
53	91,848	11.15	1,024	53	97,276	3.85	375
54	90,824	12.26	1,113	54	96,901	4.23	410
55	89,710	13.50	1,211	55	96,491	4.82	465
56	88,499	15.04	1.331	56	96,026	5.37	516
57	87,168	16.72	1,457	57	95,510	5.97	570
58	85,711	18.35	1,573	58	94,940	6.80	646
59	84,138	20.18	1,698	59	94,294	7.48	705
60	82,440	21.89	1,805	60	93,589	8.42	788
61	80,636	23.89	1,926	61	92,801	9.19	853
62	78,709	25.91	2,039	62	91,948	10.36	953
63	76,670	28.46	2,182	63	90,996	11.38	1,036
64	74,488	31.06	2,314	64	89,960	12.94	1,164
65	72,174	34.13	2,463	65	88,796	14.22	1,263
66	69,711	37.12	2,588	66	87,534	16.14	1,413
67	67,123	40.57	2,723	67	86,121	17.64	1,519
68	64,400	43.76	2,818	68	84,602	19.89	1,683
69	61,582	47.31	2,913	69	82,919	21.51	1,784
70	58,669	50.50	2,963	70	81,136	24.05	1,951
71	55,706	54.98	3,063	71	79,184	26.18	2,073
72	52,643	59.34	3,124	72	77,111	29.67	2,288
73	49,519	64.66	3,202	73	74,823	32.33	2,419
74	46,317	69.62	3,225	74	72,404	36.64	2,653
75	43,093	76.05	3,277	75	69,751	40.03	2,792
76	39,816	81.99	3,264	76	66,959	45.55	3,050
77	36,551	89.65	3,277	77	63,909	49.80	3,183
78	33,274	96.53	3,212	78	60,726	56.78	3,448
79	30,062	103.53	3,112	79	57,278	64.71	3,706
80	26,950	110.31	2,973	80	53,572	73.54	3,940

#19. BLOOD PRESSURE ANALOGY

A. PURPOSE:

To demonstrate the effect of reducing the diameter of simulated blood vessels.

B. APPROPRIATE AGE GROUP:

Primary through Middle School

C. EQUIPMENT:

1. Two equal size plastic beakers or jars
2. 1/2" and 1/4" tubing
3. 1/2" and 1/4" plug
4. Water
5. Sink or container to collect water

D. PROCEDURE:

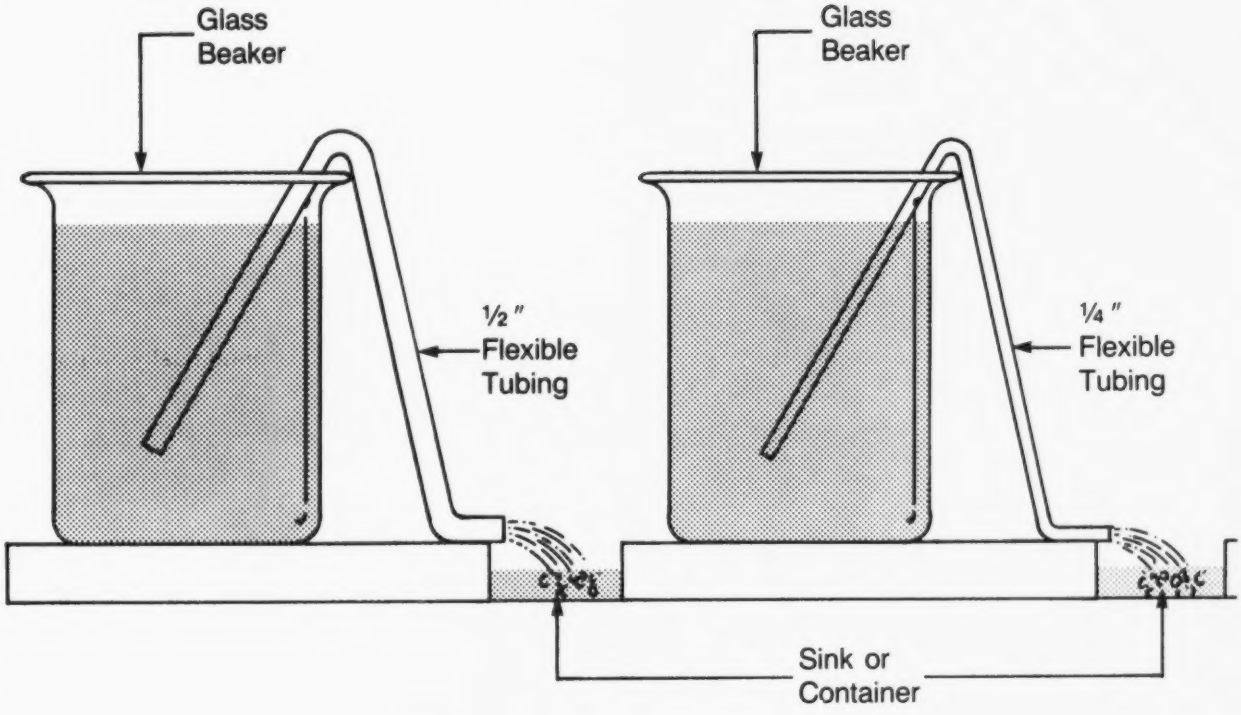
1. Insert one tube with plug in each beaker, with tubing 1" from bottom of beaker.
2. Fill beakers with equal amounts of water.
3. Have students remove plugs from both tubes (over sink or container).
4. Observe differences in the distance and force with which the water leaves each tube.
5. Using equal volumes of water, students can time both experiments and mathematically compare time to empty into the different size tubes.

E. KEY POINTS FOR DISCUSSION:

1. What is blood pressure?
2. Why does the beaker with the 1/4" tube empty with a greater force? (This is measured by the distance of the stream of water leaving the tube).
3. In a human, what effect might this constriction have on blood flow?
4. What is high blood pressure?
5. What can be done about high blood pressure?

Related Experiments: #10,26,30,31

#19 Blood Pressure Analogy



#20. PARTICULATE MATTER FOUND IN CIGARETTES

A. PURPOSE:

To demonstrate that particulate matter found in cigarette smoke will pass through filter paper.

B. APPROPRIATE AGE GROUP:

Intermediate through Secondary School

C. EQUIPMENT:

1. Hand squeeze pump
2. 1 filter flask
3. Glass tubing (or plastic, if available)
4. Plastic cover
5. Filter paper
6. Flashlight
7. Cigarette and safety matches
8. 1 Buchner filter funnel or similar device
9. One-holed stopper

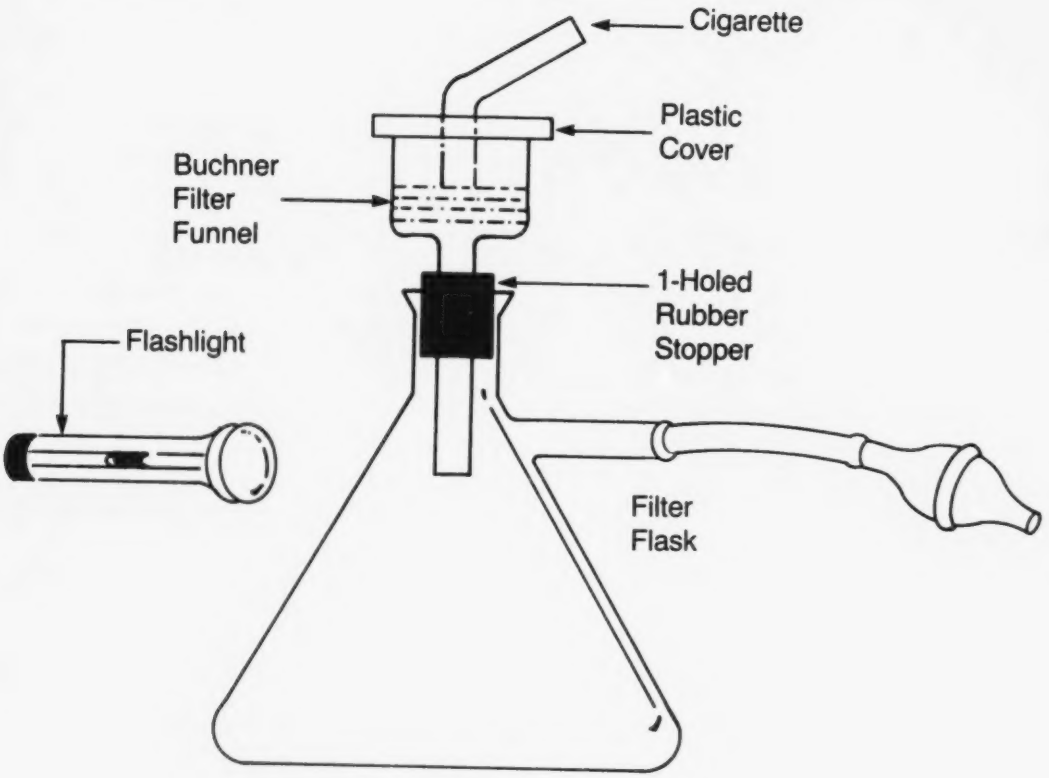
D. PROCEDURE:

1. Set up filter apparatus as shown.
2. Moisten filter paper and place in funnel.
3. Vacuum pump grease may be used to seal the lid or cover on the funnel. Glass tubing is slipped through a small hole in plastic cover.
4. Start cigarette smoking with vacuum source. Observe safety precautions.
5. Note tar residue on filter paper. Observe the smoke particles which pass through the filter paper by directing flashlight on the contents of the filter flask.

E. KEY POINTS FOR DISCUSSION:

1. How is the filter paper in this experiment similar to the lungs when smoking?
2. How do your lungs defend themselves?
3. What happens to particulate matter that is coughed up? (most is swallowed - health consequences unclear)
4. What other methods does the body use to rid itself of this foreign matter?

#20 Particulate Matter Found in Cigarettes



#21. THE EFFECT OF TAR ON GROWING PLANTS

A. PURPOSE:

To demonstrate the harmful effects of tar on living things.

B. APPROPRIATE AGE LEVEL:

Intermediate through Secondary School

C. EQUIPMENT:

1. Smoking machine (referred to in experiments #6 & #7)
2. Cotton pellets
3. Several growing plants
4. Gloves (or wash hands)

D. PROCEDURE:

1. Using the smoking machine, collect a sample of tar on a cotton pellet. Use gloves or wash hands when working with tar sample.
2. Wipe the stems of several growing plants with the tar-saturated pellet. Use plants with different leaf thicknesses.
3. Keep several of the same kind of plants as controls (no action taken).
4. Note the difference over a period of time.

E. KEY POINTS FOR DISSCUSSION:

1. What effects do tar have on the plants?
2. What is tar?
3. What might occur in the human body when tissue is exposed to tobacco tar?

#22. SMOKELESS TOBACCO EFFECTS

A. PURPOSE:

To demonstrate that smokeless tobacco produces biological effects on living things.

B. APPROPRIATE AGE GROUP:

Middle through Secondary School

C. EQUIPMENT:

1. Conventional apparatus for simple destructive distillation
2. Smokeless tobacco
3. Water
4. Cotton pellets
5. Plants (such as coleus)
6. Insects
7. Sprayer or syringe

NOTE: *A lab set-up is very helpful for conducting this experiment.*

CAUTION: *Gloves should be worn and care should be taken to avoid contact with nicotine.*

D. PROCEDURE:

1. Assemble conventional apparatus for destructive distillation.
2. Place several pinches of chewing tobacco or snuff in a Pyrex test tube.
3. Apply heat until reaction is complete, and observe that liquid tar has been distilled out. Do not overheat or tar will become hard.
4. Soak cotton pellet in the liquid tar, wipe the stems of several growing plants. Keep some plants as controls to observe differences.

VARIATION:

1. Soak cotton pellets in mixture of water and smokeless tobacco.
2. Squeeze liquid from pellets into simple spray device.
3. Use on insects to test for insecticide effects of nicotine found in tobacco. Care should be taken to avoid spraying self or others.

E. KEY POINTS FOR DISCUSSION:

1. Is smokeless tobacco a safe alternative to cigarette smoking? Why or why not?
2. How are the two types of tobacco different? Similar?
3. What does smokeless tobacco do to the mouth, gums and teeth?
4. What are the major health effects that may result from habitual use of chewing tobacco?
5. Are chewing tobacco or snuff just a passing fad in the United States?

#23. OBSTRUCTIVE PROPERTIES OF TAR

A. PURPOSE:

To demonstrate the obstructive effects of an accumulation of tar or similar substance.

B. APPROPRIATE AGE GROUP:

Primary through Middle School

C. EQUIPMENT:

1. Funnel and filter paper
2. Beaker
3. Tar or analogous substance like molasses or syrup

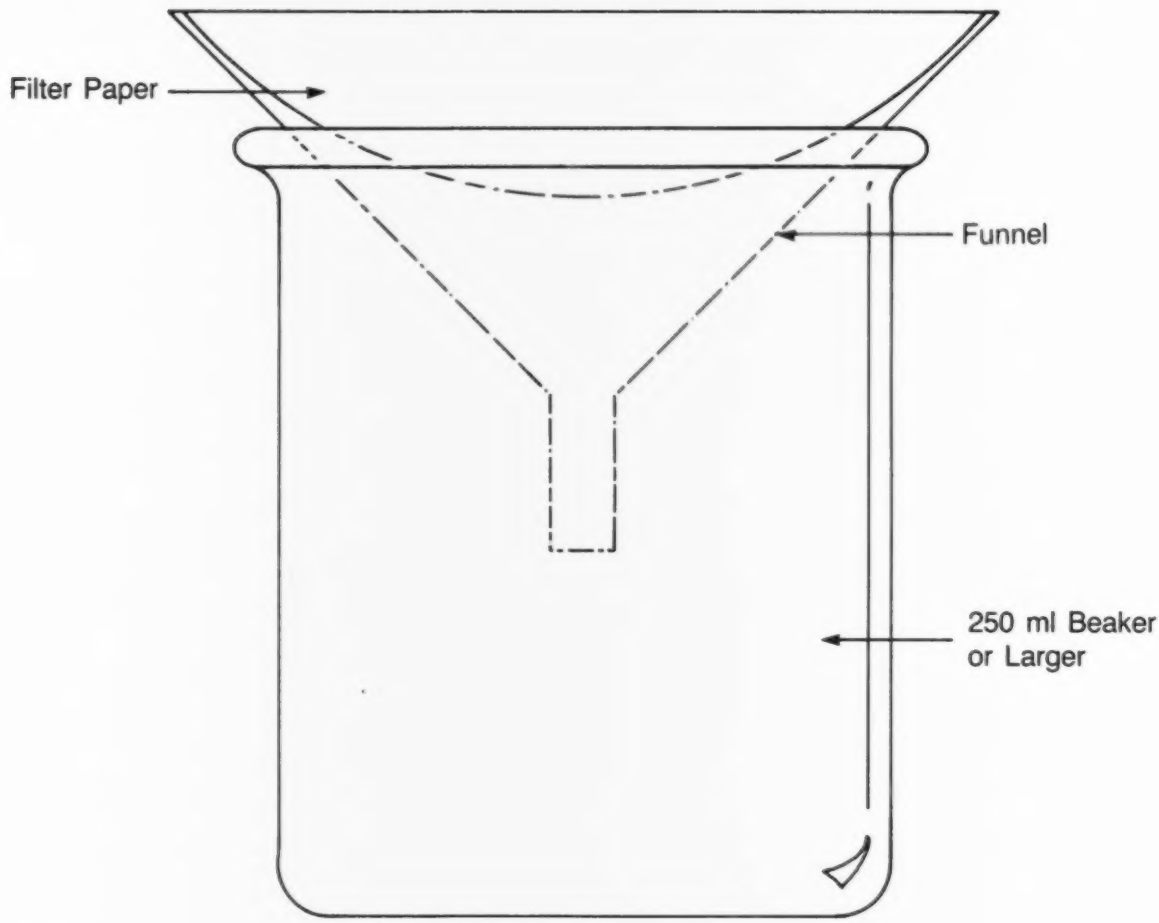
D. PROCEDURE:

1. Set up filter paper in funnel and pour measured amount of water into the beaker, observing free flow. Record the time required.
2. Take fresh piece of filter paper, coat with tar (or dark molasses - analogous substances)
3. Place in funnel and pour in the same amount of water. What are the effects? Record time required.

E. KEY POINTS FOR DISCUSSION:

1. What does the filter paper represent in your body? The water?
2. When and where would similar obstructions occur in the human body?
3. With cigarettes?
4. Would there be an accumulation problem?
5. What might be the health effects?

#23 Obstructive Properties of Tar



#24. THE INFLUENCE OF CIGARETTE SMOKE ON FISH

A. PURPOSE:

In the smoke delivered from a cigarette there are some 4,000 substances. Most of them are not readily recognized by name, but a few such as lead, arsenic, cyanide, nicotine, formaldehyde, and carbon monoxide are well known. The purpose of this experiment is to demonstrate the effect smoke can have on fish when they are compelled to absorb the chemicals in cigarette fumes.

B. APPROPRIATE AGE GROUP:

Middle through Secondary School (Note: This experiment requires strict controls or the *fish may die.*)

C. EQUIPMENT:

1. 2 or 3 Goldfish
2. 500 CC flask
3. Quarter-inch glass tubing
4. 2 Two-holed rubber stoppers
5. Water
6. Cigarettes and matches
7. Hand squeeze pump

D. PROCEDURE:

1. Assemble equipment as illustrated.

2. Light the cigarette, squeeze hand pump so that smoke will bubble through the water containing the fish.

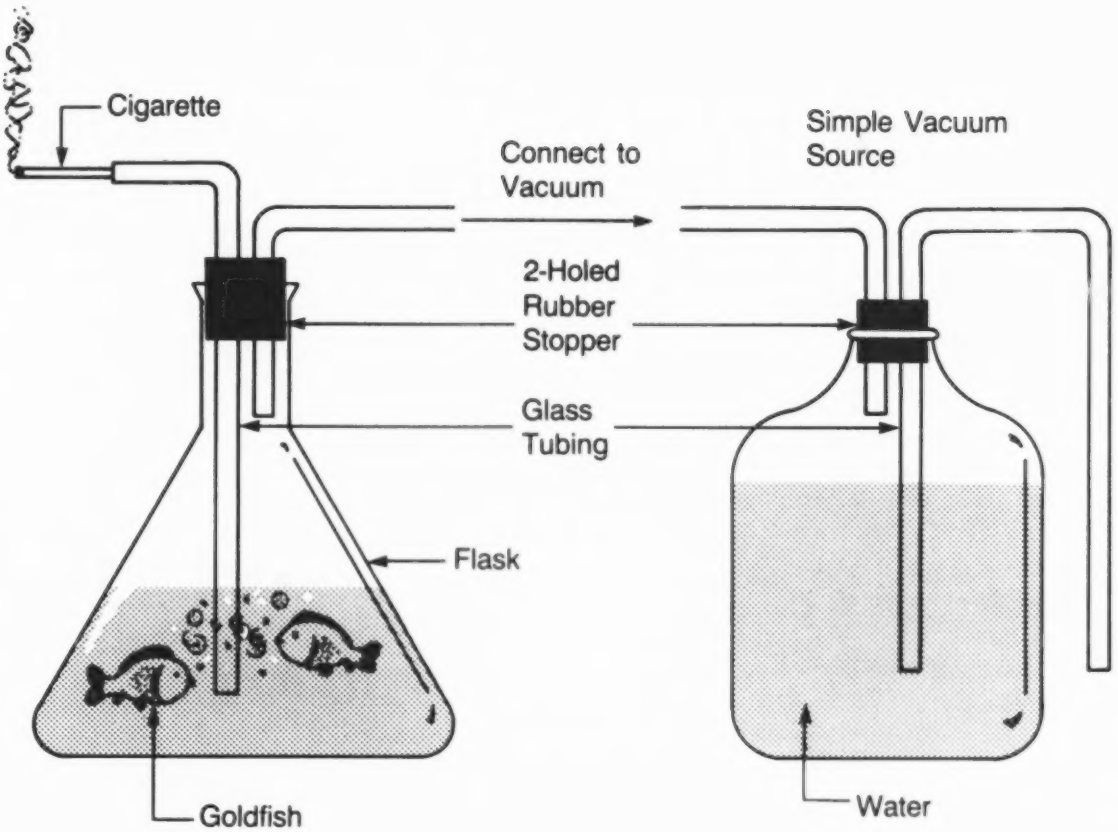
3. By the time three to ten cigarettes have been consumed, the toxic agents in the smoke should begin to affect the fish causing them to lose their equilibrium.

4. As soon as the fish lose their equilibrium and begin to roll to one side, they shoud be removed from the water and placed immediately in fresh water. If this is not done promptly, this experiment will be fatal to the fish. Have an empty container and a container with fresh water at hand. Do not pour the contaminated water directly into the fresh. Place a net over the empty container and pour the fish into the net. Then transfer them to the fresh water. Do not dip the net into the fresh water as it contains toxic ingredients from the contaminated water. Let the goldfish stay in the clean water for about one hour and then repeat the above transferring procedure as you put the fish into the aquarium.

E. KEY POINTS FOR DISCUSSION:

1. What were the effects on the fish?
2. Would humans suffer the same effects?
3. What are the effects of cigarette smoke on humans?
4. Does a fish's respiratory system work like ours?

#24 Influence of Cigarette Smoke on Fish



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#25. A DEMONSTRATION OF THE IMMEDIATE EFFECTS OF SMOKING A SINGLE CIGARETTE *

A. PURPOSE:

To demonstrate, in a simple experiment, the immediate effects of smoking.

B. APPROPRIATE AGE GROUP:

Middle through Secondary School

C. EQUIPMENT:

1. 2 liter clear screw cap plastic soft-drink bottle with cap and one spare cap
2. 2 cotton balls
3. A piece of clean white paper
4. 2 clear water glasses, each containing one cup of clean tap water
5. A pointed blade such as an icepick or scissors (be careful)
6. Filter cigarettes, matches
7. Small piece of modeling clay
8. Red marking pen
9. "Poison" label (optional)
10. Something to catch ashes

***CAUTION:** Be careful with matches and ashes*

D. PROCEDURE:

NOTE: *Advance preparation required—Teacher should make a hole the size of a cigarette using a pointed blade with a gentle motion and poking a hole through bottle cap center from outside.*

1. Assemble smoking machine - - rinse soft-drink bottle thoroughly and remove label.

2. Insert cigarette gently into cap from outside. The filter end should protrude no more than 1 cm on the inside. (If plastic liner in cap is dislodged, snap it back into cap). Be careful not to break or puncture the cigarette.

3. Tease cotton from a cotton ball and place it over and around the filter tip so that it covers the inside of the cap and remains securely lodged in it. Place "control" cotton ball on piece of white paper.

4. Screw the cap with the cigarette in place onto the bottle and apply small pieces of clay or masking tape around the base of the cigarette to seal possible air leaks (or use vaseline).

5. Light the cigarette tip and gently squeeze the bottle between fingers and thumbs, effectively "smoking" the cigarette as you alternately squeeze and release. Unscrew the cap when forcing the air out of the bottle so the air won't go through the cigarette.

6. Now remove cap with cigarette butt in it and close bottle with spare lid. Note that the end of filter is stained.

7. Examine cotton and place it next to "control" cotton ball for comparison.

8. Pour glass of clean water into smoke-filled bottle and shake.

9. Pour liquid back into glass for comparison with "control" glass of water. Note differences.

* This experiment is used by permission and was developed by:
K.H. Ginzel and Alan E. Schnur
Department of Pharmacology
University of Arkansas for Medical Sciences
Little Rock, Arkansas 72205

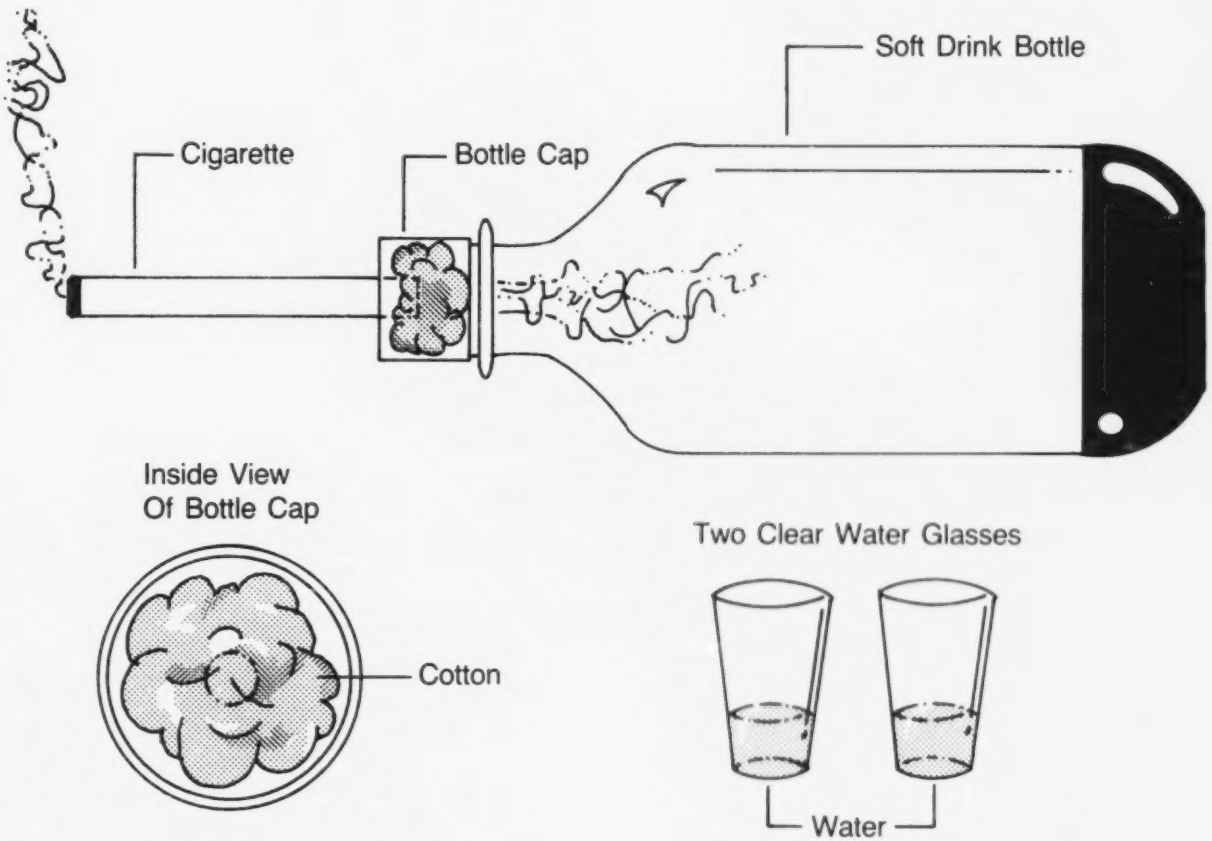
E. KEY POINTS FOR DISCUSSION:

1. What changes were seen during the experiment in the cotton and water?
2. What substances caused these changes?
3. Name the three most important substances in cigarette smoke—nicotine, tar and carbon monoxide.
4. What are the effects of nicotine and carbon monoxide (toxic agents) on the human body?
5. What are the effects of tar on humans (carcinogenic agent)?
6. What are the unpleasant social aspects of smoking (bad breath, stained teeth, side stream smoke, etc.)?

VARIATION:

1. Slide a second clear plastic bottle over the glowing cigarette tip during the demonstration and collect the "side stream" smoke in it. Use this to focus on the problem of involuntary or passive smoking.

#25 A Demonstration of the Immediate Effects of Smoking a Single Cigarette



#26. EFFECT OF SMOKING ON SKIN TEMPERATURE

A. PURPOSE:

To demonstrate that smoking lowers skin temperature.

B. APPROPRIATE AGE GROUP:

Middle through Secondary School

C. EQUIPMENT:

1. Digital thermometer (usually available from a science lab; cost approximately $1.50)
2. Volunteer adult smoker
3. Cigarettes

D. PROCEDURE:

1. Using the digital thermometer on forehead, measure skin temperature of volunteer smoker before smoking a cigarette.
2. Measure skin temperature of volunteer smoker after smoking just one cigarette.
3. Note temperature change before and after (temperature lowered).

VARIATION:

1. Try on wrists or arms.

E. KEY POINTS FOR DISCUSSION:

1. What constituents of cigarette smoke cause this constriction?
2. What might be the effects on health?
3. Why do smokers have cold feet?
4. What is Raynaud's phenomenon disease?
5. Can you identify any other problems this blood vessel constriction might cause?

Related Experiments: #19, 28, 30, 31

#27. SMOKING AND BLOOD PRESSURE #1

A. PURPOSE:

To demonstrate the possible effects of smoking on blood pressure.

B. APPROPRIATE AGE GROUP:

Middle through Secondary School

C. EQUIPMENT:

1. Blood pressure cuff and stethoscope
2. Volunteer adult smoker

NOTE: *It may be helpful to cover blood pressure in a previous class.*

D. PROCEDURE:

1. Arrange for school nurse to take and compare blood pressure of volunteer smoker before and after smoking.
2. Note increase (if any) in systolic pressure measurement as a result of smoking.

E. KEY POINTS FOR DISCUSSION:

1. Blood pressure—What is it? Define systolic and diastolic pressure.
2. What are the potential harmful health effects of high blood pressure?
3. How does smoking increase systolic measurement?
4. What are the long term effects of smoking related to blood pressure?
5. What is your ideal or target blood pressure? What can you do to reach this level and maintain it?

Related Experiments: #10, 19, 26, 28, 31

#28. SMOKING AND BLOOD PRESSURE #2

A. PURPOSE:

To demonstrate the effect of smoking on the heart and circulatory system.

B. APPROPRIATE AGE GROUP:

Middle through Secondary School

C. EQUIPMENT:

1. Wrist watch
2. Cigarettes and safety matches

D. PROCEDURE:

1. It is recommended that students do this experiment with an adult smoker at home and record their findings. The arterial pulse, taken at the wrist, is an accurate indication of the heart rate. One can take the pulse by placing two middle fingers of the right hand on the thumb side of the wrist of the subject.

2. The subject's pulse should be taken two or three times to establish a base line accuracy. In each instance record the pulse rate as the number of pulsations felt per minute.

3. Have the subject light a cigarette, then take the pulse as he/she has concluded the 3rd or 4th puff. When the cigarette is finished, take the pulse every fifteen minutes until the pulse rate returns to normal.

4. Chart the findings on a graph and determine how many extra beats one pack of cigarettes causes the subject. Since with each beat the heart pumps approximately 70 ml of blood, calculate the extra volume of blood that will be pumped by the heart induced by smoking one package of cigarettes.

E. KEY POINTS FOR DISCUSSION:

1. What were the results? How many more times does a smoker's heart beat than a non-smokers? In a minute, hour, lifetime (lifetime would be less, actually, because smokers die sooner!)

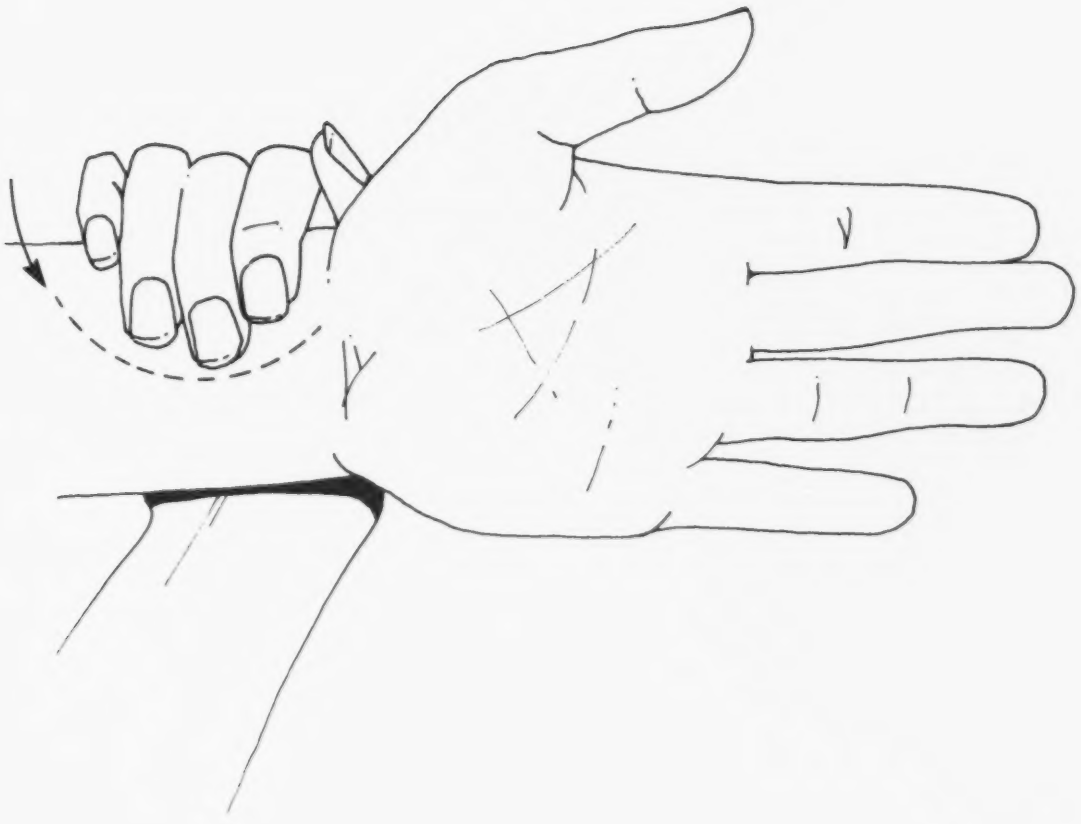
2. How do you think the increased pulse rate will affect the smoker over a long period of time?

3. Constriction of blood vessels - how does this affect the heart?

4. What is the difference between increased pulse during exercise (healthful) and increased pulse from smoking (harmful).

Related Experiments: #10, 19, 26, 27, 31

#28 Smoking and Blood Pressure II



#29. CARBON MONOXIDE LEVELS IN SMOKERS VERSUS NON-SMOKERS

A. PURPOSE:

To demonstrate one *immediate* effect of smoking—inhaled carbon monoxide in a smoker's breath.

B. APPROPRIATE AGE GROUP:

Intermediate through Secondary School

C. EQUIPMENT:

1. Ecolyzer *
2. Volunteer smokers and non-smokers
3. Air bags, rubber bands

D. PROCEDURE:

Two variations, based on age groups.

***VARIATION -1* (Elementary):**

1. Have volunteer smoker and adult non-smoker each take a deep breath and hold for 10 seconds.
2. Have each volunteer exhale a small amount of breath (about 1/3); exhaling remaining 2/3 of air into bag. Secure with rubber band.
3. Attach air bag of non-smoker to Ecolyzer according to instructions, and take reading of ppm (parts per million) CO in expired air of non-smoker.
4. Repeat with air bag of smoker.
5. Compare the two readings (perhaps construct graphs).

***VARIATION -2* (Secondary):**

1. Have all students provide sample of expired air in air bags.
2. Take readings on each sample.
3. Compare readings of smokers to non-smokers in class.
4. If possible, try to get at least one smoking student to volunteer to go without smoking for at least 3 days. Measure his/her air before and after the 3 day period. Note changes in CO levels after just 3 days of cessation. You could also compare blood pressure (exp. 28 & 29 and tension (exp. 33) changes.

E. KEY POINTS FOR DISCUSSION:

1. What is carbon monoxide? (The stuff that comes out of the tail pipe of your car.)
2. What are the carbon monoxide levels found in normal, non-smoking population?
3. What are the effects of smoking *cessation* on CO levels in smoker after 3 days?
4. What are the harmful effects of high levels of CO in bloodstream—on heart, on concentration?
5. What are the effects of maternal smoking on unborn baby?

Related Experiments: #27, 28, 33

* Ecolyzer is an expensive machine (@ $1,200.00 or more), but often can be borrowed from local chapters of the American Lung Association, hospitals or universities.

#30. USING PHYSIOLOGICAL TESTING TO TEACH ABOUT SMOKING

A. PURPOSE:

To demonstrate the effects of smoking on the human body.

B. APPROPRIATE AGE GROUP:

Middle through Secondary School

C. Equipment:

1. Telemetry (biofeedback) equipment for measuring such parameters as skin temperature, respiration rate, heart rate and blood pressure.

NOTE: *The "Experiments in Human Physiology" package listed in the appendix provides most of these materials.*

D. PROCEDURE:

1. Set up and calibrate the equipment for measuring a single physiological function.
2. Select several volunteers and measure their performance on the test.
3. Conduct the test three times on each subject and use the middle score or most common score.
4. Have the volunteers smoke (parental permission required) while conducting the test.
5. List and compare the results.

E. KEY POINTS FOR DISCUSSION:

1. What causes the score variation?
2. How might the results change with someone that has smoked for 5, 10, or 25 years?
3. What diseases are related to smoking?
4. How does smoking contribute to disease?

Related Experiments: #19, 26, 27, 28, 31

#31. INVESTIGATION OF NICOTINE'S EFFECT ON LUNG ORGANISMS

A. PURPOSE:

To demonstrate the effect of a nicotine solution on living organisms (while the solutions contain more than just nicotine, the effects observed will be due primarily to this substance).

B. APPROPRIATE AGE GROUP:

Middle through Secondary School

C. EQUIPMENT:

1. Water life such as daphnia, paramecium or goldfish (keep moist) ideally 1 per two students.
2. Separate containers of cigarette tobacco, pipe tobacco, chewing tobacco, and snuff soaked over night in water.
3. Microscope
4. Slides

NOTE: *Lab facilities would be very useful.*

D. PROCEDURE:

1. Place living organism into water containing one of the tobacco solutions.
2. Observe effect on its metabolism through a microscope.
3. In the case of the goldfish, place drops of the solution on the tail fin. Hold fish in cotton gauze and keep fish moist. Note the movement of blood in the vessels of the tail.
4. Repeat procedure, using different solutions.
5. Note differences.

E. KEY POINTS FOR DISCUSSION:

1. Is nicotine found in *all* types of tobacco?
2. Nicotine has a constrictive effect on the blood vessels. What are the physical reactions that may occur as a result of this effect? (measured heart rate, elevated BP)
3. Which component in cigarette smoke promotes physiological dependency?
4. What are the effects of nicotine on the human body?

Related Experiments: #10,19, 26, 27, 28

#32. SMOKING AND VITAMIN C INVESTIGATION

A. PURPOSE:

To help students recognize the effect of nicotine from tobacco on the essential nutrient, vitamin C, and to practice skills in titration and analytic thinking.

B. APPROPRIATE AGE GROUP:

Secondary School

C. EQUIPMENT:

1. Syringe with graduated markings
2. Beakers
3. 1 fresh orange, 1 sample dried or canned orange juice
4. Iodine solution: dissolve .60 grams of potassium iodine with 50 ml of ethanol. Put contents in 1 liter beaker, and add 950 ml of distilled water.
5. Medicine dropper
6. Starch indicator (1 tablespoon or 15 ml soluble starch, such as potato starch, dissolved in 1 liter distilled water).
7. Dilute HCL (Hydrochloric Acid)

D. PROCEDURE:

Students will first investigate the level of vitamin C in various kinds of orange juice through titration.

1. Measure 50 ml of the juice to be sampled and place it in a wide-mouthed jar or beaker.
2. Add 2 drops of dilute HCL to sample and mix thoroughly.
3. Add 2 medicine droppers full of starch indicator and mix.
4. Fill a syringe with iodine solution to 10 ml.
5. Titrate the sample with the iodine solution *one drop* at a time, mixing after each drop. Count how many drops are used. Keep adding and mixing until a purple color persists. This is the end point.
6. Record how much iodine solution was needed to reach this point (number of drops or number of mls used).
7. Run a second sample of the same juice type as an accuracy check. If they come out very differently, run a third. Average the three for your final figure. This is an indicator of vitamin C in this 50 ml sample. The more iodine needed to change the color, the more vitamin C is present.
8. Repeat above procedure with remaining types of orange juice (at least 3) and make a graph that shows the relative amount of vitamin C in the different samples.

Students will then demonstrate the effect of tobacco smoke on vitamin C content.

1. Titrate the amount of vitamin C in a 250 ml (1 cup) sample of orange juice.
2. Using another sample of the same kind of orange juice, bubble smoke from one cigarette through the sample. This can be done most successfully by using a smoking machine to pump the smoke from a cigarette into the orange juice (see experiment #34 to set up a simple smoking machine).
3. The presence of nicotine will reduce the amount of vitamin C in the titration.

E. KEY POINTS FOR DISCUSSION:

1. Do all orange juice products contain the same percentage of vitamin C?
2. What is the function of vitamin C in the body?
3. How does cigarette smoking impair the body's ability to utilize vitamin C?
4. Could other nutrients in the body also be affected by the use of tobacco?
5. How would chewing or dipping tobacco affect vitamin C in the body?
6. Does the form of orange juice affect the outcome of this experiment?

SOURCE: Adapted from, "Health Yourself," American Cancer Society, 1984.

#33. TREMOR-TENSION AND SMOKING

A. PURPOSE:

To show that smoking causes unsteadiness of hand due to tensing of muscles.

B. APPROPRIATE AGE GROUP:

Secondary School

C. EQUIPMENT:

Hand steadiness or tremor-tension tester.* If not available, construct according to diagram. Components are:

1. 6 volt bell, standard buzzer, or counter (@56011 at approximately $29.00, available from Lafayette Instrument Co., P.O. Box 1279, Sagamore Parkway, Lafayette, IN 47902)
2. 6 volt lantern battery (screw terminals preferred)
3. Box or cabinet of suitable size and test probe (as a multimeter replacement probe)—Radio Shack #274-720
4. Brassplate (aluminum 2/@ $.99) about 3 inches in diameter or a rectangle 3 x 1 inch drilled with three test holes, which measure 1/2", 1/4", and 1/8" in diameter

D. PROCEDURE:

1. Volunteer adult smoker holds the stylus tip inside the hole in the plate for 30 seconds, trying not to touch the tip to the sides which will set off the bell, buzzer, or the counter (depending on construction).
2. Student non-smoker volunteer repeats same procedure.

VARIATION:

1. Ask a student who has consumed several drinks which have caffeine to carry out the experiment. How might two or more sources of caffeine act together?

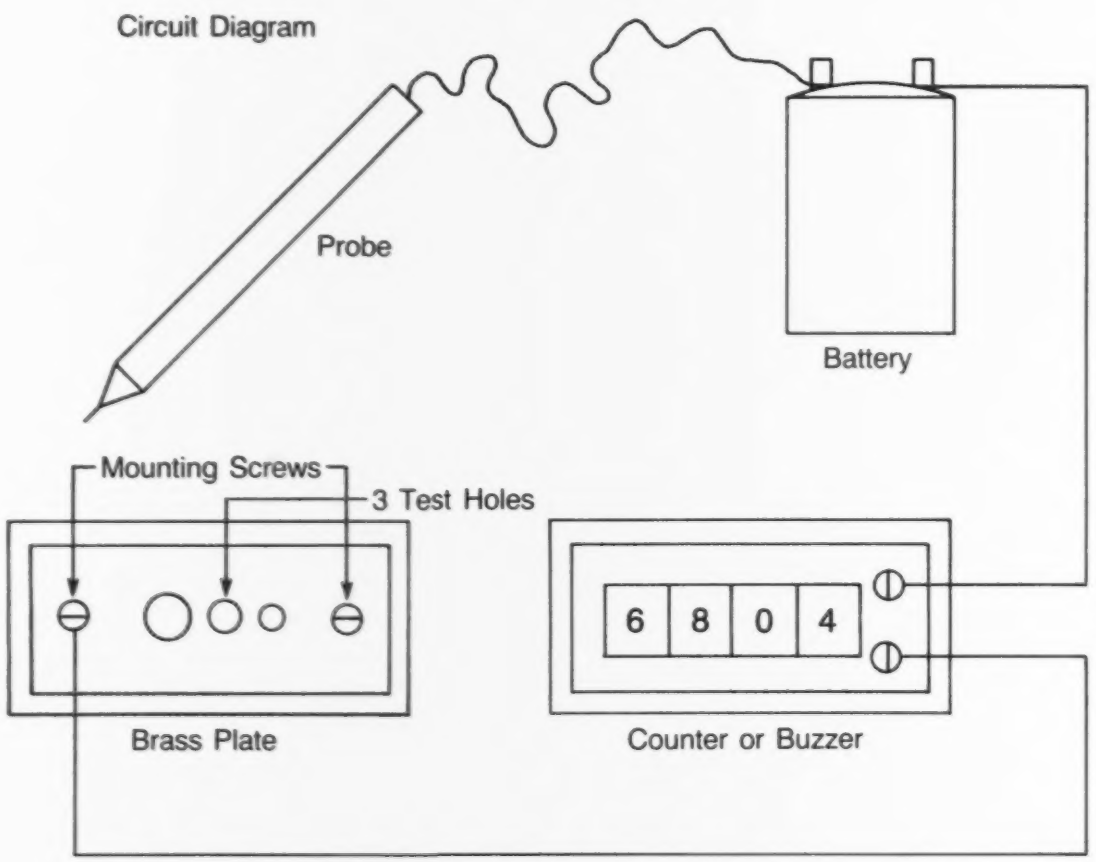
E. KEY POINTS FOR DISCUSSION:

1. What influences the smokers performance?
2. Smoking myth—"It relaxes me." This experiment demonstrates that muscles actually tense with smoking.
3. How does smoking affect other parts of the body?

* May be available from local Chapters of the American Lung Association.

#33 Tremor Tension and Smoking

Hand Steadiness or Tremor-Tension Tester



#34. MAKE A SMOKING MACHINE

A. PURPOSE:

To devise a simple smoking machine for demonstrating the effects of smoking.

B. APPROPRIATE AGE GROUP:

Intermediate through Middle School

C. EQUIPMENT:

1. A plastic detergent bottle with cap
2. A 5-10 cm tube about the size of a cigarette
3. Cotton ball
4. Clay
5. Cigarette
6. Safety matches
7. Ash tray

D. PROCEDURE:

NOTE: *Best to conduct near an open window.*

1. Rinse the bottle and dry before using.
2. Make a hole in the cap the size of the tubing. (See Experiment #24)
3. Put tubing into the hole and seal with clay.
4. Put the cotton ball into one end of the tubing and the cigarette into the other.
5. Screw on the cap.
6. Force the air out of the bottle by pressing on it firmly.
7. Light the cigarette and begin pumping the bottle slowly and steadily.
8. Remove the bottle cap when pushing the air out of the bottle then replace before pulling air through the cigarette. You can also poke a hole in the bottle to let the air escape, then cover the hole before pulling air in through cigarette.

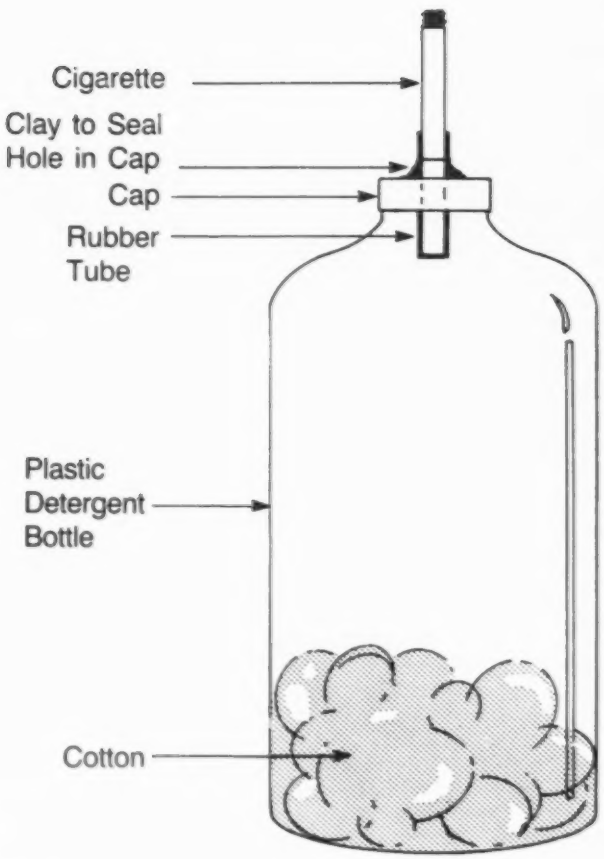
VARIATION:

1. Rub the cotton ball used in the smoking machine on the leaves and stems of several plants. What happens?

E. KEY POINTS FOR DISCUSSION:

1. What does the cotton ball look like after the smoking test?
2. What does the bottle look like?
3. What do you think cigarette smoke does to the inside of a person's lungs? Teeth? Throat?

#34 Making a Smoking Machine



#35. USING A COMMERCIAL SMOKING MACHINE

A. PURPOSE:

To observe the collection of tar in the simulated air tubes and lungs of a commercial smoking machine. Examples of commercial smoking machines:

1. Smokey Sam—A.N.T. Educational Supplies, 5160 Carob Way, Riverside, CA 92505.
2. The Mechanical Smoker - Truth about Smoking, P.O. Box 6322, Salt Lake City, Utah 84106.
3. The Billboard Smoker—Spenco Medical Corp., P.O. Box 8113, Waco, TX 76714-8113.

B. APPROPRIATE AGE GROUP:

Primary through Secondary School

C. EQUIPMENT:

1. Smoking machine
2. Cigarettes and matches

D. PROCEDURE:

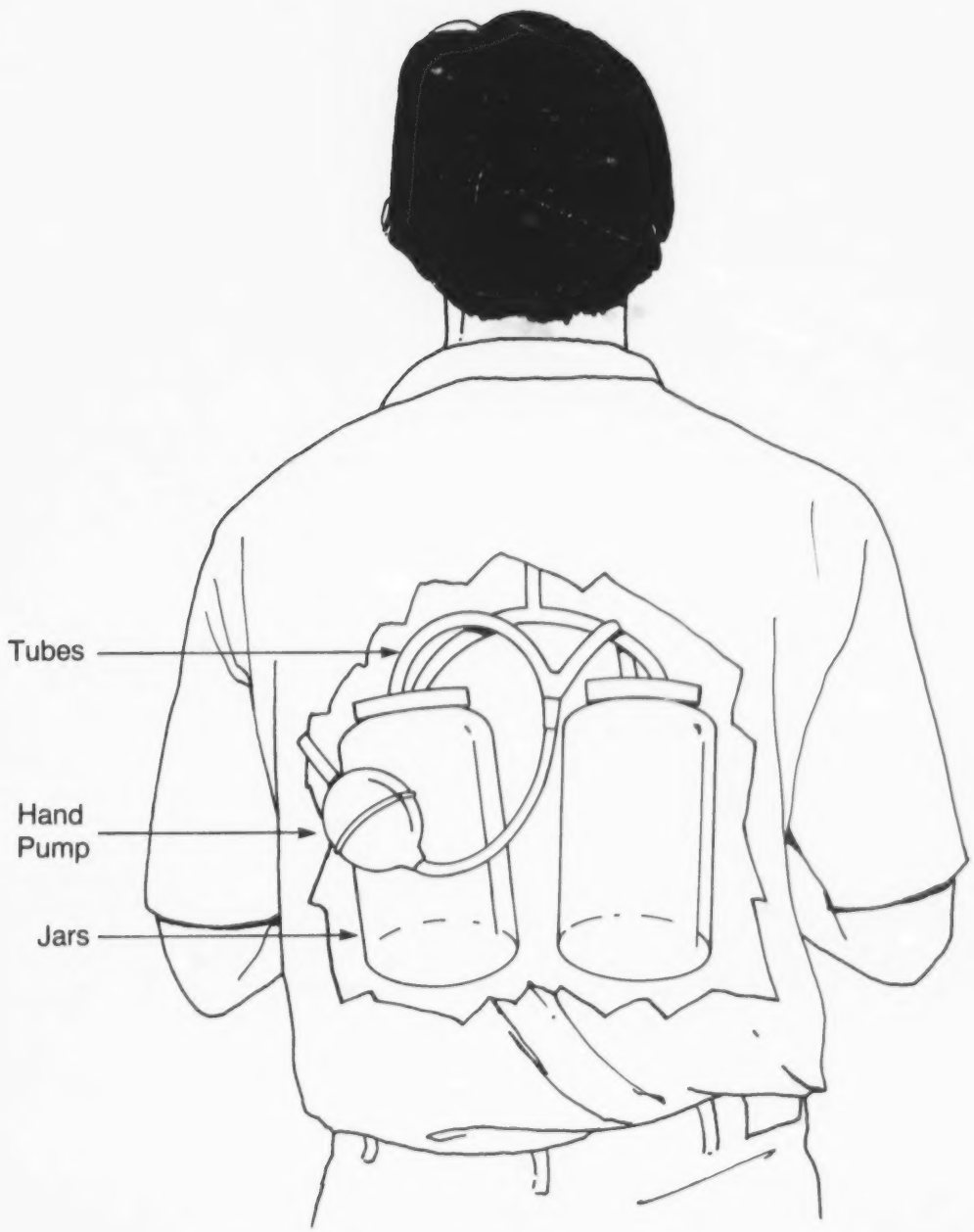
1. Place lighted cigarette in mouth of the smoking machine.
2. Observe the accumulation of tar.

NOTE: *Commercial smoking machines can be used in a variety of ways. Plays or interviews can be developed through the use of audio tapes. These activities can be correlated with other subject areas.*

E. KEY POINTS FOR DISCUSSION:

1. What is happening to the machine's lungs?
2. What happens to the passages (tubes)?
3. How does tar affect the human body?
4. What are other effects of smoking on the human body?

#35 Using a Commercial Smoking Machine



#36. EFFECTS OF TOBACCO USE ON SOFT OR HARD TISSUES IN MOUTH

A. PURPOSE:

To demonstrate that use of chewing tobacco, snuff, or cigarettes may affect soft or hard tissue in the user's mouth.

B. APPROPRIATE AGE GROUP:

Primary through Secondary School

C. EQUIPMENT:

1. Volunteer adult smokers, chewers (if students, with parental permission), non-smokers, non-chewers
2. Labels, pins, and marker pen
3. Large piece of cardboard or poster board
4. Painter's smock
5. Worksheets for students
6. Scissors or X-acto knife

D. PROCEDURE:

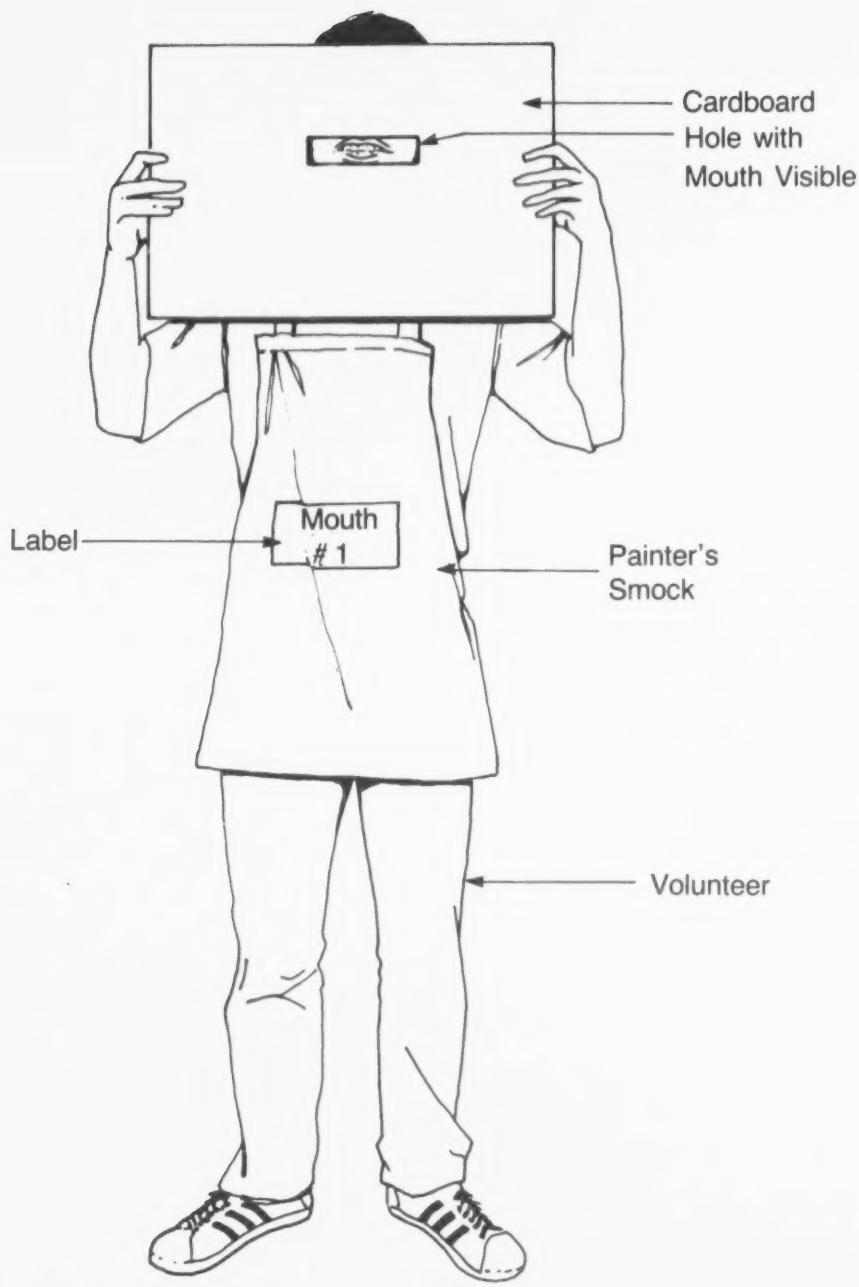
NOTE: *Advance preparation required—cut hole in cardboard large enough to view mouth area.*

1. Assign numbers to each volunteer, ie. Mouth #1, Mouth #2, etc.
2. Without revealing identity, have first volunteer put painter's smock on and place himself or herself behind cardboard so just his or her mouth is visible through the opening.
3. Ask volunteer to open mouth, display teeth and inside of lower lip, and allow 3 or 4 students to observe closely.
4. Ask students to note on worksheet the category (smoker, non-smoker, chewer, etc.)
5. Repeat procedure with remaining volunteers.

E. KEY POINTS FOR DISCUSSION:

1. What is leukoplakia? What causes this condition?
2. What oral problems are associated with the use of chewing tobacco? Snuff?
3. How might cigarette smoke affect the tissues in the mouth?
4. Why might it be impossible to observe differences between volunteers in this demonstration?
5. Why are dentists important in the early detection of oral cancer?
6. Explain the phrase, "kissing a smoker is like licking a dirty ashtray."

#36 Effects of Tobacco Use on Soft or Hard Tissues in Mouth



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#37. THE EFFECTS OF CARBON MONOXIDE ON BLOOD

A. PURPOSE:

To test the effects of carbon monoxide from cigarette smoke on animal blood.

B. APPROPRIATE AGE GROUP:

Secondary School

C. EQUIPMENT:

1. Simple smoking machine, as shown in diagram
2. Cotton pellets
3. Animal blood
4. Cigarette or pipe with pipe tobacco
5. Safety matches
6. Sodium oxalate solution
7. Yeast
8. Extra bottle for control solution

D. PROCEDURE:

NOTE: *Advance preparation—obtain animal blood from butcher shop. Keep the blood from coagulating by adding one part sodium oxalate solution to nine parts blood.*

1. Set up smoking machine with water in bottle A, animal blood solution in bottle B, and water in bottle C.
2. Have an adult volunteer smoke cigarette (or pipe). Observe smoke coming through the tube from bottle A to bottle B.*
3. Observe what happens to the blood solution (CO causes blood to turn deeper red).
4. Add a fresh yeast culture to the blood solution in bottle.
5. Add a yeast culture to sample of blood in control bottle (not attached to smoking machine). Note differences (oxygen release is impaired).

E. KEY POINTS FOR DISCUSSION:

1. What gas in cigarette or pipe smoke causes a change in the coloration of the blood? What is happening?
2. What happens in the blood of a smoker when he/she inhales the carbon monoxide in tobacco smoke?
3. What effect does the displacement of oxygen by CO in the red blood cells have on the cardiovascular system?
4. How might the impairment of the oxygen carrying capacity of the cells be overcome?
5. When is it too late to stop smoking? How much of the harm to the body is irreversible? What damages caused by smoking can the body repair?

* Bottle C is merely a trap to keep blood from frothing into the pump or aspirator.

#37 The Effects of Carbon Monoxide on Blood

Fig. 1

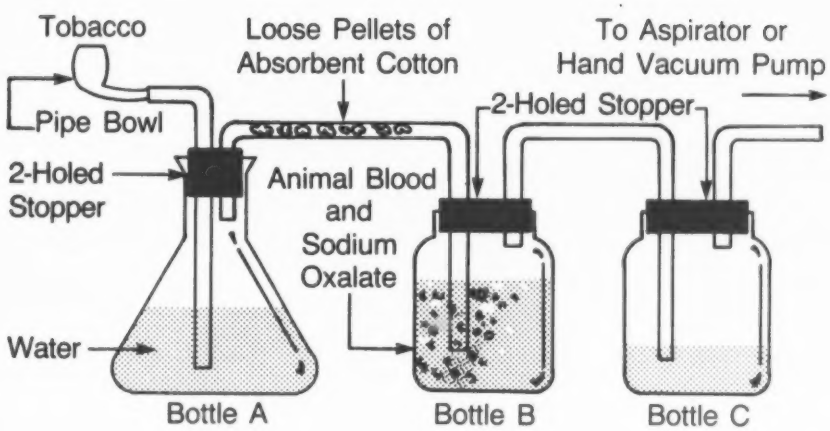
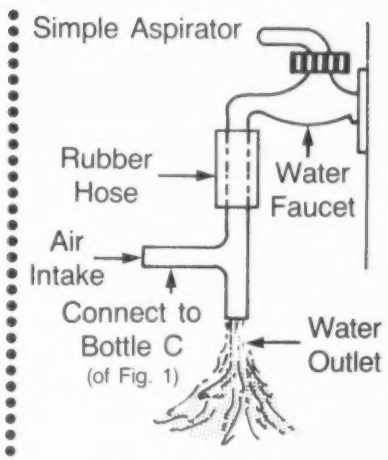


Fig. 2



#38. SIMPLE EXPERIMENTS

1. Place a drop of solution containing paramecia on a microscope slide. With the low power of a microscope, observe the movement of these one-celled organisms. Blow smoke from a collection flask on the specimen. Note the effects on the paramecia.

2. Cut apart various brands of cigarettes. Observe and compare their composition. Compare under a microscope.

3. Test a variety of brands of cigarettes to determine which deposits the least waste products using cotton, wool, or other filter materials described in several experiments.

4. Do the same as in #3 above testing the filter part of the cigarette. Run a test with the filter on, then run another test with the filter cut off and compare results. Determine which is most efficient.

5. Design a test to check advertised claims, "less tar," "more taste," etc.

6. What kinds of chemicals—tars, acids, etc.—does a smoker swallow as they dissolve with saliva in the mouth? What do these chemicals do to the esophagus and stomach?

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#39. DESIGN YOUR OWN EXPERIMENT

A. PURPOSE:

To design an experiment that illustrates the harmful effects of cigarette smoke, cigar smoke, pipe tobacco, chewing tobacco, or snuff.

B. APPROPRIATE AGE GROUP:

Any Age Group

C. EQUIPMENT:

Any equipment that would be generally available to students.

D. PROCEDURE:

1. Students brainstorm possible experiments.
2. Students develop an experiment idea in small groups and submit to teacher for approval.
3. What must observers look for?
4. What information should be written down or charted?
5. Try out the experiment when approved by teacher.
6. How will you evaluate the effectiveness of the experiment?

E. KEY POINTS FOR DISCUSSION:

1. How does this experiment demonstrate the dangers of smoking?
2. What can be done to improve the experiment?
3. Is this experiment safe enough for others to try?
4. What grade level does it best suit? Why?

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II. SOFTWARE LISTING

NOTE: *No software listed has been evaluated and no endorsement is implied or intended.*

1. Control Smoking/Calm Nerves

(Expando-Vision). Uses subliminal messages to help user control smoking and calm nerves at the same time. Control Health Software: Vic-20; Commodore 64; Atari 400; 800 (Diskette, cartridge, or tape); $37; requires electronic interface device.

ADULT

CONTROL HEALTH SOFTWARE
18653 Ventura Boulevard #348
Tarzana, California 91356

2. Smoker's Profile

Depicts in bar graph mode the increase in mortality from 20 different diseases for the smoker as compared with the non-smoker. Decrease in life expectancy is calculated, based on current smoking habits. Computerized Health Appraisals; Apple II; TRS-80 III; $100. Control Health Software: TRS-80, III, IV; $90.

ADULT

CONTROL HEALTH SOFTWARE
18653 Ventura Boulevard #348
Tarzana, California 91356

3. Why Do I Smoke?

Helps the user explore the reasons he or she smokes in a series of questions. Advanced Medical Systems: IBM-PC; $30.

ADULT

ADVANCED MEDICAL SYSTEMS
3519 South 1200 East
Salt Lake City, Utah 84106

4. Why Smoke?

Prepares a graphic report on the factors that play a role in smoking: stimulation, handling, pleasurable relaxation, tension reduction, psychological addiction, and habit. Rates the relative strengths of each. Computerized Health Appraisals: Apple II; TRS-80 III: $50.

ADULT

COMPUTERIZED HEALTH APPRAISALS
15431 Southeast 82nd Drive Suite F
Clackamas, Oregon 97015

5. Healthy Decisions?

Healthy Decisions is a program in the form of an adventure game that helps adolescents examine environmental cues which influence their choices. The American Cancer Society (written by Bob Gold): Apple II series.

ADOLESCENTS (sixth graders). Long term loan - no charge.

Contact your local American Cancer Society Unit

6. Know Smoke: Teenager

Provides a profile of smoking costs and consequences according to brand and amount smoked. Includes graphics and individual action plans for cutting down or stopping. American Cancer Society. Apple II series. No Charge - long term loan.

ADOLESCENTS

American Cancer Society
Texas Division, Inc.
P.O. Box 9863
Austin, Texas 78745

7. Cancer Risk Profile

Provides a cancer risk profile through a series of questions. American Cancer Society, Texas Division. Apple II series, TRS 80. No charge - long term loan.

ADULT

American Cancer Society
Texas Division, Inc.
P.O. Box 9863
Austin, Texas 78745

III. SUGGESTED REFERENCE LIST

References, like those listed here, would be very useful to have on hand when conducting these experiments.

American Cancer Society. *Cancer Facts 1985*. (annual update).

American Cancer Society. *Smokeless Tobacco: Cause for Concern?* Professional Education Publication, 1984.

American Cancer Society. *The Dangers of Smoking. The Benefits of Quitting*. 1980.

American Cancer Society. *Tobacco and Health*. Professional Education Publication. 1978.

Ashton, Heather and Stepney, Rob. *Smoking: Psychology and Pharmacology*. Tavistock Publications, London and New York, 1982.

Office on Smoking and Health, U.S. Department of Health and Human Services, *Smoking, Tobacco, and Health—A Fact Book*. Rockville, Maryland 20857

RESOURCE LIST

American Cancer Society (ACS) *
90 Park Avenue
New York, New York 10016
(212) 599-8200

American Heart Association (AHA) *
7320 Greenville Avenue
Dallas, Texas 75231
(214) 750-5300

American Lung Association (ALA) *
1740 Broadway 16th Floor
New York, New York 10019
(212) 315-8700

Office of Cancer Communications
National Cancer Institute
Building 31, Room 10A-18
Bethesda, Maryland 20205
(800) 422-6237

National Health Information Clearinghouse
P.O. Box 1133
Washington, D.C. 20013-1133
(703) 522-2590 (in Virginia)
(800) 336-4797 Toll Free

Office of Disease Prevention and Health Promotion
U.S. Department of Health and Human Services
300 "C" Street, S.W., Suite 2100
Washington, D.C. 20201
(202) 472-5308

Office on Smoking and Health
U.S. Department of Health and Human Services
5600 Fishers Lane
Rockville, Maryland 20857
(301) 443-1690

* Check your local Chapter